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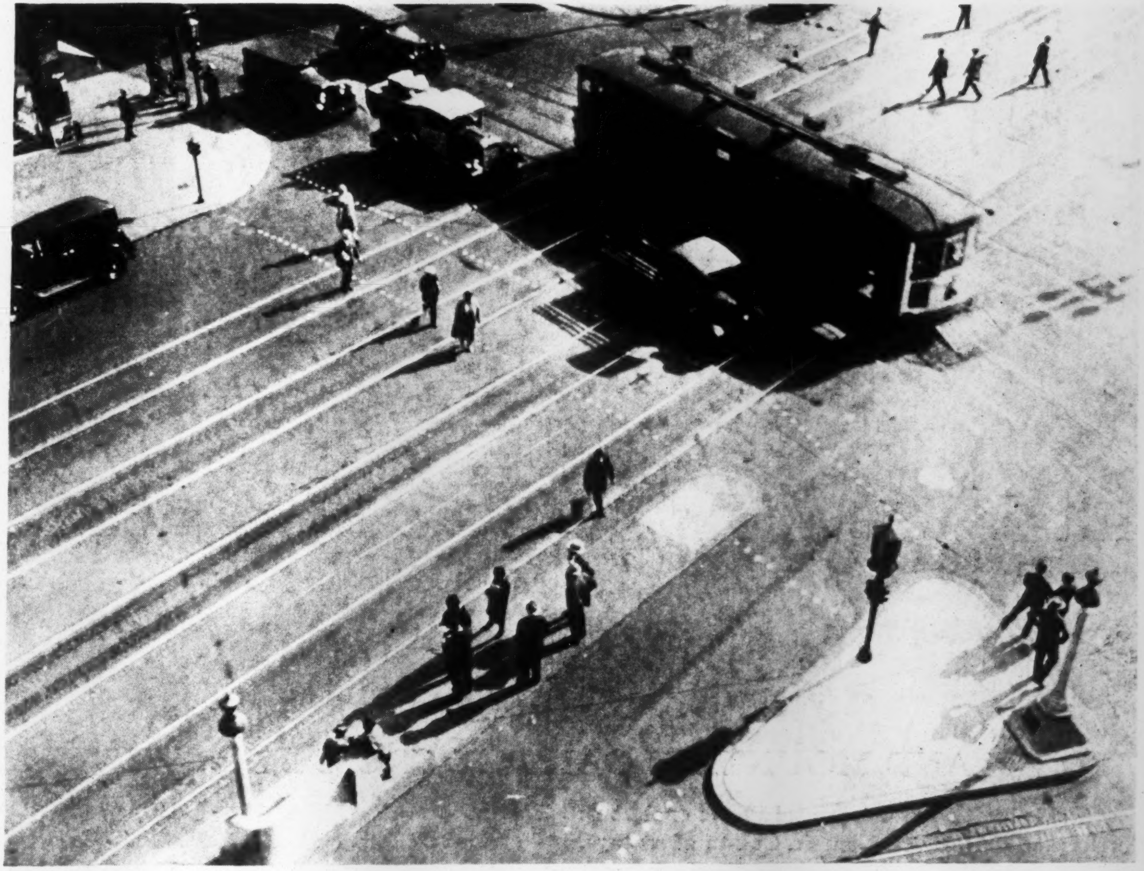

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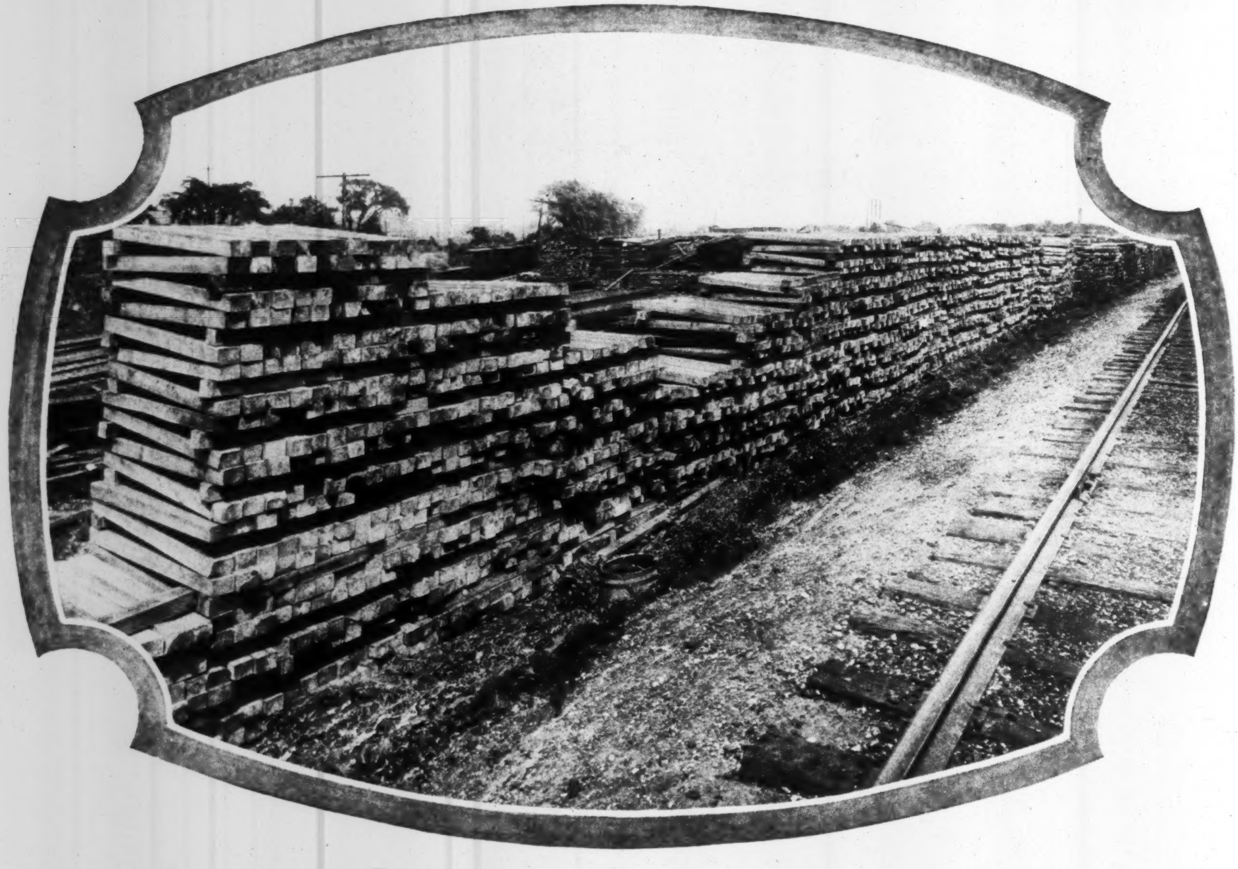

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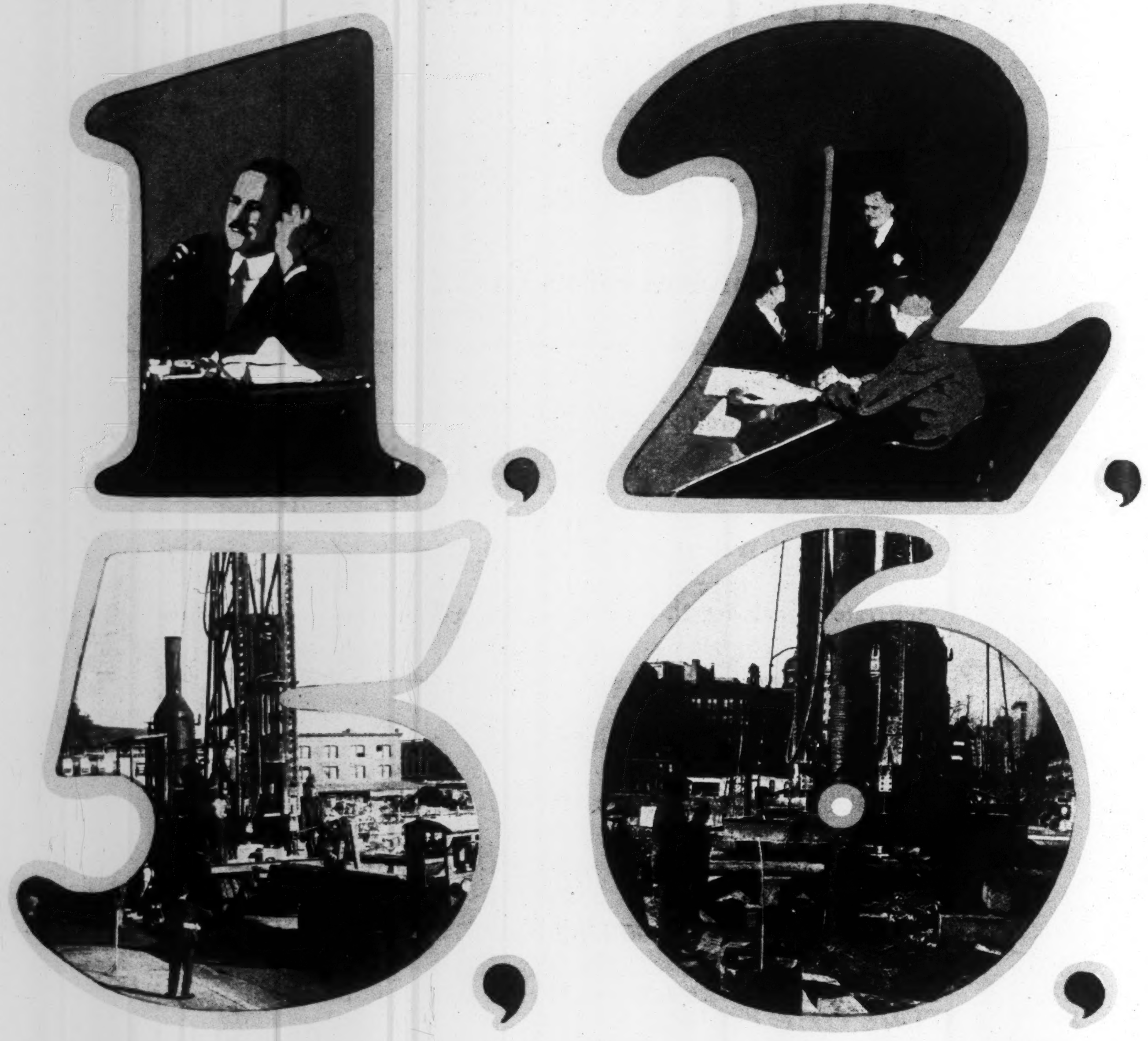

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. Schmitt, *Editor*

Volume 104 NEW YORK, APRIL 17, 1930 Number 16

A Great Case Ends

FINAL settlement of the long-drawn-out Chicago lake diversion case is made by the Supreme Court's decision of April 14 approving the Hughes report of Dec. 17, 1929, on a form of decree to bring about effective reduction of the diversion to a "negligible amount." This latter term, a significant element in the original decision of the court on Jan. 14, 1929, outlawing the diversion, is defined as 1,500 sec.-ft. Since the water-supply draft also contributes to the westward discharge of the river into the Mississippi system, the total diversion thus is limited to little over 2,500 sec.-ft. This limitation is to be achieved in eight years. Energetic prosecution of the Sanitary District's sewage-disposal program is an obvious necessity, especially in view of the progressive reduction of diversion which the decision prescribes. The order lays a heavy obligation on the city and the district. But with purposeful leadership and honest administration the obligation will not be inordinately difficult to carry out.

How Engineers May Help

ONE of the elements that promise to make the Chicago Sanitary District's course easier is participation of engineers in politics. Last week several prominent engineers contested for high offices. Joshua D'Esposito, consulting engineer and former chief engineer of the 100-million-dollar Union Station development, came through as one of three candidates for the six-year term of trustee of the Sanitary District. Thus does Chicago return to the thinking of a quarter of a century ago, when Lyman E. Cooley was considered proper timber for trusteeship. The simple argument that vast sums of money must be spent and that Mr. D'Esposito has already demonstrated administrative ability in railroad work was practically all that was used. Speaking to engineers, he said that in all his thousands of contacts in his nightly campaigns the honesty of engineers was always taken for granted. Had engineers instead of politicians dominated the district, millions of dollars would have been saved the taxpayers and the vast construction program made necessary by the growth of the district and by the demands of the federal government would be farther advanced than it now is.

Applied to Water

THESE same curative methods that Chicago engineers are utilizing have a field of application in San Francisco. Although only a few weeks have elapsed since the city assumed the control of its water-supply system, unpleasant rumors of political interference with the management are already becoming evident. Revenues for the next few years will be urgently needed to care for deferred maintenance and necessary improvements to the system; yet those in charge of the municipal management appear eager to use the revenue for reducing water rates as a gesture to show the effectiveness of the new management, taking advantage of the argument that it would be an incentive to new industries. A more insidious rumor is the suggestion that the politicians entertain hopes of diverting the surplus to the general fund, which would permit the usual political talking point of reduced taxes. It is paramount that engineering requirements receive first consideration and, after the past few years of uncertainty over the sale of the Spring Valley Water Company's properties, it seems likely that extensive improvements and additions to the system may be necessary. As between the two other possibilities, after engineering needs have been fully satisfied, only one is worthy of consideration, and that is the prorating of the benefits to the various consumers through a reduction in the water rates. Possibly, should the subsequent introduction of the Hetch Hetchy supply permit material savings, there might be justification in talking of a general tax reduction from water revenues, but this is not the present problem. Starting from scratch with the management of a going concern. San Francisco has an opportunity to demonstrate successful management of a large municipal water system.

Politics in Engineering

FURTHER evidence of the need for healthy engineer influence in municipal administration comes from Detroit, where in the last few weeks politics has got in the saddle and run down engineers long in the employ of the city. A change in mayors was followed not long afterward by failure of a stretch of recently constructed sewer. This seems to have given the mayor a most welcome opportunity to replace the commissioner of public works, an engineer in the employ of the city for thirty years past, by a politician; and not only a politician, but a man who has been interested in city contracts, including the bonding company that had gone surety on the contract for the sewer in question. The city engineer having indorsed a proposal for an investigation of the collapsed sewer, he also was promptly fired by the new commissioner of public works. The nature, extent and causes of the sewer failure cannot be determined until the sewer is dewatered. Whether an impartial investigation and report will then be made is uncertain in the light of the latest reports at hand, which state that two of the three prominent local engineers chosen by the council to make an investigation on its behalf had refused to serve, while the third had not yet accepted the appointment. Until an impartial report on the sewer failure has been made by competent engineers it is only fair to assume that bad politics rather than bad engineering is the cause of the recent upheaval at Detroit. This is all the more a serious matter for the engineers, taxpayers and citizens of Detroit because of the vast and costly engineering works under construction and projected in the rapidly growing city.

Clearness in Welding Drawings

BY CUSTOM and necessity, standard symbols constitute the language of engineering drawings. Shorelines of rivers and lakes are designated by symbolic ripples. Sand is shown by dots, grass by sprouting clumps of short dashes. On drawings of steel structures, the rivet is denoted by one of various standard symbols expressing the way in which it is to be used—shop-driven, field-driven, countersunk near or far side—and the result is so clear that no explanatory notes are required. With the advent of welding a need arose for a new symbolic language. But it was a need that was not officially recognized for a number of years, with the result that each individual shop devised its own nomenclature. When welding developed a rapid growth and structural welding entered the field, this lack of standardization proved a distinct disadvantage. Now, a committee of the American Welding Society has worked out a set of symbols that can do much to remedy the situation. The recommendations of this committee should be embraced by every designer and shop draftsman to the end that welding drawings may become in some measure standardized and brought to the same degree of clearness that characterizes topographical and geological maps and riveted structural steel drawings. Also, such use will assist in revealing at an early date any lack of adequacy in the recommended symbols.

Inadequate Knowledge

DEFINING natural materials with respect to their engineering use is a field of notorious difficulty. Construction men will recall how troublesome has been the identification of "rock," "hardpan" or "quicksand"—typical examples of materials which, though definite, are often involved in fog. Even greater difficulty attends the engineering consideration of broken stone, gravel and other mineral aggregates. The history of the efforts made in Detroit to establish a uniform specification for aggregates is witness to this difficulty, although the Detroit specification involves only size and grading and does not touch such subjects as quality and proper fields of use, both of which are deeply shrouded in uncertainty. The obstacles to satisfactory definition of mineral aggregates lie not alone in the wide variability of the materials themselves but quite as much in lack of knowledge as to the qualities which they should have to be most serviceable. How can we proceed in comparing two lots of aggregate for use as railroad ballast, as road metal, as drain filter filling, or as concrete aggregate? Such a problem is amenable only to empiric judgment, supplemented by a few test methods supported more by tradition and faith than by factual knowledge. Until quality can be determined from quantitative engineering data, mineral aggregates will remain one of the least satisfactory elements of engineering construction and will be a source of trouble to producer and user alike. Broadly planned research might improve this condition markedly in the course of a few years. But such research has not yet been organized, largely because each class of users of aggregates believes that its own problems are individual and unrelated to those of the other classes. When these individualistic attitudes give way to a proper recognition of the unity of the study work involved, a constructive attack on present ignorance concerning aggregates will be possible.

Dangerous Road Tests

WITH the national death toll on the highways mounting close to 30,000 a year, public authorities and the automobile industry should take steps to abolish the unnecessary and foolhardy endurance and speed tests frequently made over public roads, often to advertise or demonstrate various makes of cars. One of the most asinine of these tests was recently made in Florida, when a West Palm Beach driver, shackled to the steering wheel, drove continuously over the road for 100 hours. At the finish of this grueling grind, which covered more than 3,100 miles, the driver slumped over the wheel completely exhausted. Think of the number of innocent persons on the highways at the same time as this fool that were in potential danger during the greater portion of this stunt! Suppose this driver's nerves had snapped while he was out on the main highway. A serious accident involving others besides himself would have been likely. Yet the town proclaimed him as a hero. The long-distance speed runs made across the country are another source of danger to the public. One made over the heavily traveled road between Boston and New York, averaging more than 50 miles an hour, is an example. Recently a car was driven from Florida to New Jersey, 1,381 miles in 23 hours and 2 minutes, an *average* speed of 60 miles per hour. Coast to coast routes are favorites of speed maniacs trying to establish a record for something or other. There are other places besides public highways to test the speed and endurance of motor cars. Our highway death toll is already a disgrace; barring the public roads to sensational record seekers will eliminate one possible source of this tragic toll.

Channel Tunnel Prospects Poor

WHAT benefits or financial returns can accrue from the construction of a 36-mile submarine railway tunnel between England and France is a question that finds but a vague answer in the recent report of a committee appointed by the British government to consider the economic aspects of this ancient project, now revived, as described elsewhere in this issue. Mildly favorable conclusions presented in the report are offset by qualifications and reservations. True, one conclusion is that the tunnel would be of economic advantage to the country by creating new traffic and thus increasing trade; but the report itself and the evidence which it reviews give little support for such a conclusion. The essential question remains, What financial return can be expected on the enormous capital cost of $155,000,000?

On this vital subject the committee is silent, except for the statement that it believes the tunnel can be built and operated for a cost which would not require higher rates than those of the present short sea routes. It is careful to qualify even this statement by saying it assumes that the present traffic estimate is correct and that the cost estimate will not be exceeded. A preliminary estimate by consulting engineers for the investigating committee is approximately $154,500,000 for the tunnel line complete, but exclusive of stations, electric locomotives and generating plants. This is predicated on favorable construction conditions; any difficulties would increase the cost, and the figure given may be regarded as the irreducible minimum.

The committee holds definitely that the work must be carried out by private enterprise, without financial assistance by the government. It also believes that the tunnel will be "an economic benefit" to the country. Just what this phrase means is not clear. It is conceivable that the tunnel might be an economic benefit to the country as a whole (though this is highly uncertain) and still be a financial failure in itself. But private enterprise that puts capital into a project does so with a very definite expectation of financial return. It is true that the connecting railway in France is giving some support to the project, though the English railway is lukewarm. But their assistance must be mainly as to approaches, terminal facilities, equipment and operation, since they would hardly risk any large amount of capital in a project of such problematic value as an investment. The issue is further confused by the following statement in a published letter from a representative of the promoters:

"It does not matter a scrap whether our Channel tunnel is a paying proposition or not; it does not matter a scrap whether it pays a large or a small dividend, or no dividend at all. From the point of view of public utility the Channel tunnel, when built, must be admitted to be a great new traffic facility. It will create its traffic, as all large transport undertakings have done. . . . When we have built our tunnel we shall have completed a work which will make London the traffic terminus of the world."

This statement has a familiar sound in its highflying and exaggerated style. It is plain promotion language that means little or nothing. Private capital must always expect adequate returns upon its investment. And in regard to future financial developments, if the project should be authorized it appears probable that eventually, if not now, the government would be asked to pay.

It is to be noted that the tunnel project is put forward almost exclusively as a passenger transport facility, warranted by the extent of passenger traffic. The basis of traffic estimates is the known total of 2,266,000 passengers by all cross-Channel sea routes in 1928. Then the geometric increase on the shorter routes for past years is calculated and its extension into the future is estimated. On this somewhat uncertain foundation are pyramided figures including: (1) the total traffic of two short sea routes which would be superseded; (2) the estimated—or guessed—proportion of the traffic of each of the several longer sea routes which may be taken away by the tunnel; (3) the people fearing seasickness who would never cross by sea but might cross by tunnel, and (4) the new or additional traffic to be attracted or developed by the tunnel as a new transportation facility. The gross results in different estimates, but all prepared by those more or less favoring the tunnel, vary by more than 100 per cent, from 1,525,000 to 3,577,000 for the first year of tunnel operation. By independent calculations and estimates the government committee arrives at 2,357,000, or practically the average of the high and low figures.

Of the present traffic, 75 per cent is British, but the tunnel promoters claim that the tunnel will vastly increase the influx of foreigners. A more general and less biased view is that these "foreigners" are less travel-minded than the British and in any case would prefer the attractions of continental cities and resorts. Further, as one railroad officer has pointed out, the "so-called horrors" of the sea passage may be offset by the "unknown horrors" of a 36-mile tunnel under the sea. Fear of seasickness, although much stressed by tunnel promoters, is probably a very minor factor affecting prospective Channel traffic. A greater objection is the confusion and inconvenience incident to the detraining, transfer (with baggage and all travel paraphernalia) to a steamer and then a second transfer to another train. It is this objection which makes a good argument for the car-ferry idea, especially with steamers capable of handling an entire train.

From the evidence reviewed in the report it appears that in general the project is regarded with little favor and much doubt and opposition by the English commercial, manufacturing, agricultural, shipping and railway interests. Even the railway with which the tunnel would be connected estimates a loss of revenue. Thus, this latest and most hopeful report on the project contains nothing to show the need or value of the tunnel as an investment, as an economic benefit, or as a work of public necessity and convenience.

Suburban Traffic a Problem

NOT a few American railways have to deal with rapidly growing suburban traffic and find difficulty in handling it effectively on main-line tracks. Rarely, however, does this terminal-zone traffic actually approach the saturation point. One of the London lines of the London & Northeastern Railway, in England, finds itself in this situation. The condition is so serious, in fact, that plans are under consideration for an underground electrically operated railway from the city terminal along the route of this particular line as a supplement to the present facilities.

There now are multiple tracks on this line (partly depressed and partly elevated), but widening for additional tracks is said to be out of the question on account of the prohibitive cost of such work through a congested city district. According to a study by the railway, electrification of the present line would not give enough increase in capacity to meet the requirements. No figures are given as to the train service or the number of passengers, but the 10- to 15-mile length of the proposed underground line would apparently serve the outlying suburban communities and give them a rapid-transit service which cannot be provided in any other way.

As yet the project is tentative. But it is an interesting indication of problems which come with increased density of city day population and the simultaneous building up of suburban districts. Electrification of suburban service has been adopted in several cases in this country, but there are few supplementary suburban lines. Several proposals have been made to erect elevated structures along the right-of-way of certain main-line railways, as on those entering Chicago, but where made by outside interests these are opposed by the railways. Since suburban traffic usually brings little or no profit, plans for the construction of additional facilities at large expense are not likely to meet with favor. Under such restrictions the problem of economic and effective handling of such traffic in increasing density is one which needs close study and a broad view of future or prospective conditions in order to produce a satisfactory solution.

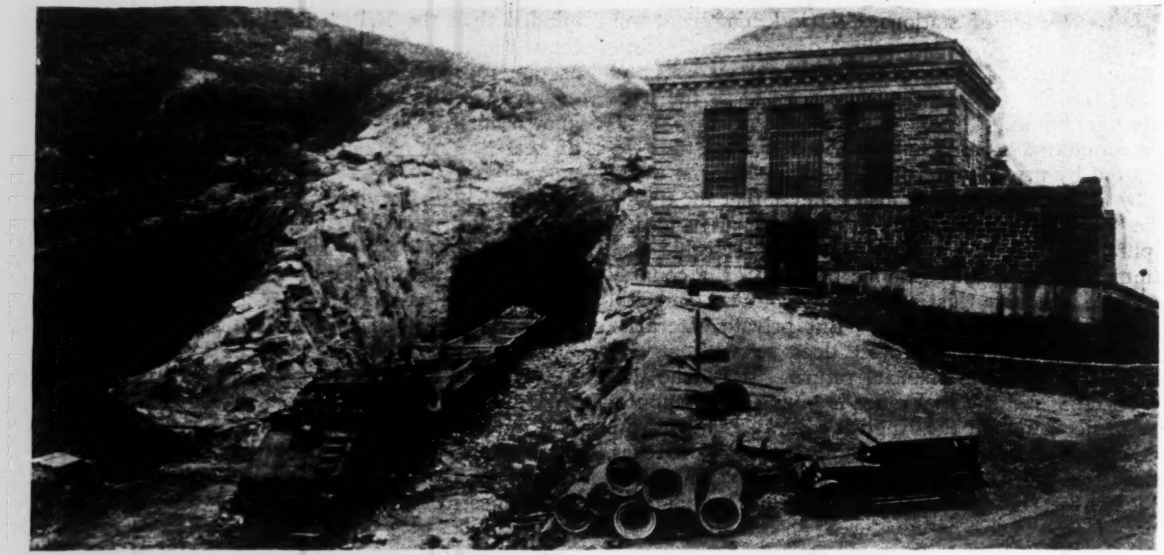


FIG. 1—NORTH PORTALS, BREAKNECK TUNNELS, N.Y.C.R.R., SHOWING PROXIMITY TO CATSKILL AQUEDUCT SIPHON SHAFT
Shovel working in new double-track tunnel. Old double-track tunnel, later enlarged, shown at extreme left

Rim Drilling and Broaching Used in Driving and Enlarging N.Y.C.R.R. Tunnels

One New Tunnel, Two Enlargements and 1,500,000-Cu.Yd. Rock Excavation on 20 Miles of Four-Tracking Built Under Heavy Traffic on Hudson Division—Breakneck Tunnel Driven Adjacent to Catskill Aqueduct Siphon

DRILLING and shooting 1,500,000 cu.yd. of rock out of cliffs towering 50 to 120 ft. above two heavily traveled tracks, driving a double track tunnel so close to the Hudson River siphon of New York City's Catskill water-supply aqueduct that rim drilling and broaching replaced usual tunnel methods, and enlarging two old tunnels, were all involved in four-tracking two 10-mile sections of existing double track on the New York Central Railroad between Garrison and Poughkeepsie, N. Y. The projects, part of the plan to four-track the Hudson division, which will complete four-tracking between Buffalo and New York City, extend from a mile south of Garrison to Beacon, and from Chelsea to Poughkeepsie, on the Hudson division of the main line. A 5-mile section between Beacon and Chelsea, a 23-mile section between Poughkeepsie and Barrytown and a 5-mile section between Tivoli and Germantown were four-tracked several years ago. Construction work on the southerly of the two sections, from Garrison to Beacon, involving 800,000 cu.yd. of rock excavation, was completed last year, but the second 10-mile section is still under construction. About 700,000 cu.yd. of rock will be excavated on this section, between Chelsea and Poughkeepsie.

Completion of these two sections of four-tracking will give the New York Central a four-track line from New York to Albany, 143 miles, with the exception of 8 miles from Peekskill north to Garrison, 5 miles between Barrytown and Tivoli and 20 miles between Germantown and Stuyvesant.

Much of the right-of-way for the existing double-track line had been blasted out of the rocky cliffs which meet

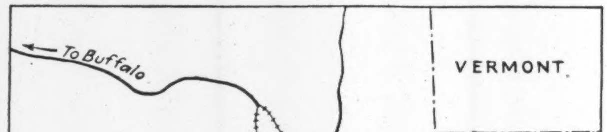

To Buffalo
VERMONT
Albany
NEW YORK
Stuyvesant
MASS.
Legend
Existing 4-track line
" 2-track line
4 track line under construction just completed
Germantown
Tivoli
Barrytown
HUDSON RIVER
Poughkeepsie
CONN.
New Hamburg
Chelsea
Garrison
Peekskill
New York
NEW JERSEY

FIG. 2—MAP OF MAIN LINE, NEW YORK TO ALBANY, SHOWING LOCATION OF FOUR-TRACKING

the river edge in many places, leaving vertical walls 50 to 120 ft. high adjacent to the northbound track. Blasting out additional right-of-way to accommodate two more tracks without interference to the 130 daily train movements on existing tracks required extreme care in shooting and handling. One of the new cuts is more than 5,000 ft. long and involved moving 450,000 cu.yd. of rock. Filling in on the river side to gain sufficient width for two more tracks was impossible in most places because of the steepness of the banks below water.

Three tunnels are involved in the projects, all on the south section. At Garrison an old double-track tunnel, 450 ft. long, was abandoned several years ago because of rotten rock conditions, and an open cut was built to the east of the tunnel to carry two tracks. To four-track this point of the line the old tunnel was enlarged to standard double-track size, lined and put back into service. At Breakneck Mountain an old double-track tunnel was carrying all traffic and although this bore was smaller than present standard, 200 ft. of its length had been lined. This tunnel was enlarged to standard double-track size and lined its full length. But before this enlargement could be attempted a new double-track tunnel was bored through Breakneck Mountain to the west of the old tunnel and adjacent to the east shaft of the Catskill aqueduct siphon crossing the Hudson River, with but 50 ft. of rock between the tunnel and the shaft. The aqueduct shaft is 1,200 ft. deep, which is the depth of the river section of the siphon. Although the water tunnel leading off to the east from the shaft under the track is 150 ft. below the surface, the shaft is full of water under pressure to the top. After the new tunnel was completed, traffic was shifted through it and the old tunnel was enlarged without traffic interference.

New Breakneck Tunnel—Because of the precarious position of the new tunnel between the much-used and partly unlined old tunnel on one side and the aqueduct shaft on the other side under pressure, a most unusual method of tunneling was used in driving this bore. Before any blasting was done a series of 2⅜-in. holes 6 ft. deep on 3-in. centers was driven around the entire tunnel perimeter except across the bottom. Special broaching tools, 1⅜x3 in., cut out the material between the holes, leaving a channel or curf around the tunnel contour. The entire face was then drilled and shot with light charges, a center heading being removed first. After mucking out, the process was repeated.

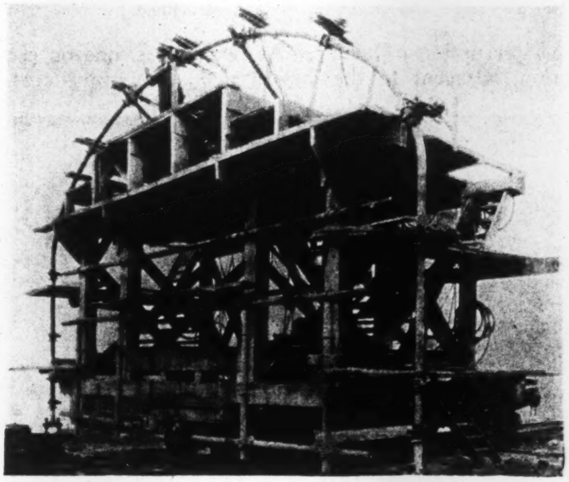
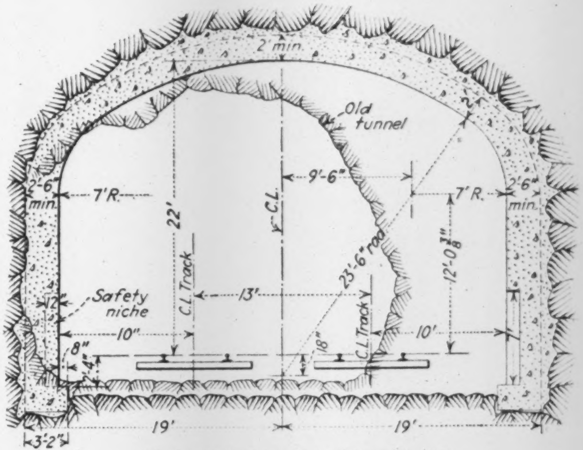
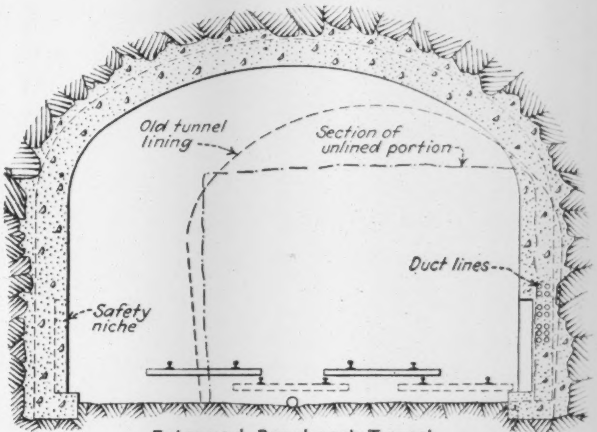


FIG. 3—DRILL CARRIAGE FOR RIM DRILLING AND BROACHING BREAKNECK TUNNELS



Enlarged Garrison Tunnel



Enlarged Breakneck Tunnel
Dimensions same as on Garrison Tunnel

FIG. 4—SECTIONS OF ENLARGED BREAKNECK AND GARRISON TUNNELS

New Breakneck tunnel section is 1 ft. larger all around than enlarged sections of old tunnels.

All of the drilling was done from two identical special drill carriages, one operating from each portal. One of these drill carriages is shown in Fig. 3. It consists of a 4½-in. pipe, bent to conform with the tunnel dimensions, carrying twelve drifter drills for the rim drilling and broaching, braced with the same size pipe, and four 4½-in. crossbars carrying columns and drills for the center heading and ring drilling. The whole is mounted on a standard flat car permitting easy and rapid handling. Air receivers and manifolds are also mounted on the same car. Jacks were provided for steadying the frame, but were found to be unnecessary.

All muck was loaded into 12-cu.yd. standard-gage cars by a 1¼-cu.yd. steam shovel burning coke (Fig. 7). The shovel, on crawler tread mounting, had to be brought out of the tunnel to permit the drill carriage to enter. Working two eleven-hour shifts per day, each heading advanced 6 ft. every two days.

Enlarging Old Breakneck Tunnel—As shown in Fig. 4, enlarging the old Breakneck tunnel was all done on one side and the top. The rim drilling and broaching method was also used at each end, using the same drill carriages as were used on the new tunnel to retain the original rock portals. Using the old tunnel as a heading,

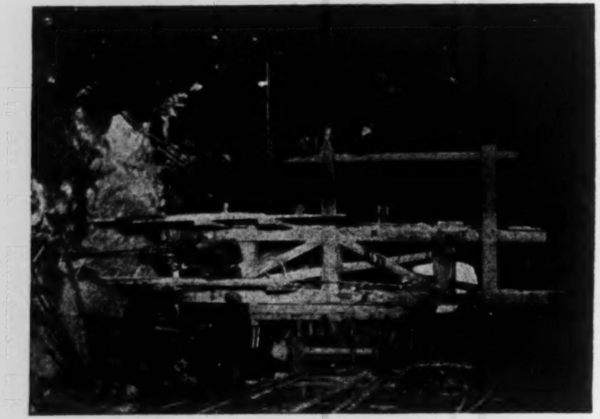


FIG. 5—DRILL CARRIAGE USED IN ENLARGING OLD GARRISON TUNNEL

stopers and drifters ring-drilled the rock so as to bring it down with light shots. Mucking out was done the same as for the new tunnel, with a coke-burning steam shovel loading into standard-gage cars. The mucking out was carried on from the north end only.

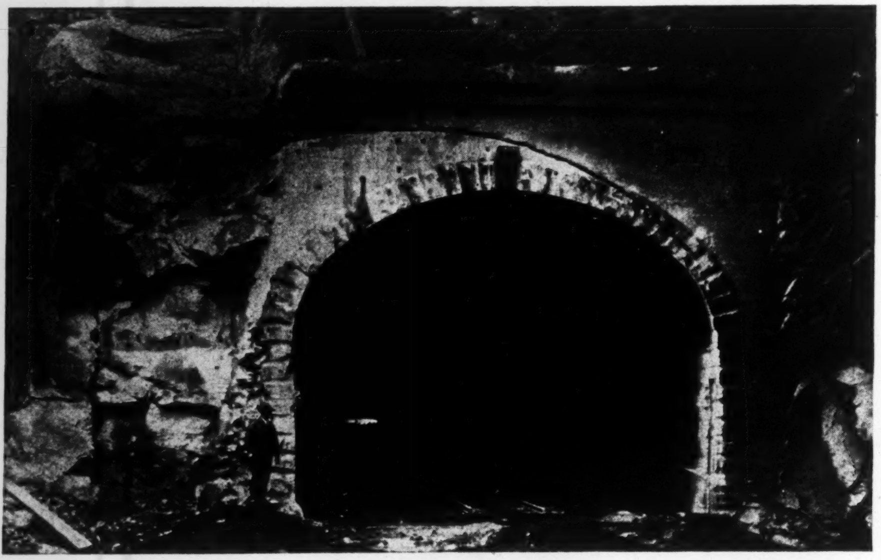


FIG. 6—SOUTH PORTAL, OLD BREAKNECK TUNNEL, SHOWING PERIMETER OF ENLARGED SECTION RIM DRILLED AND BROACHED

Only the south portal and south end of the old tunnel were lined.

Enlarging Garrison Tunnel—Although extreme care had to be taken in enlarging the old Garrison tunnel because of danger of loosening rock in the sides of the open cut but 40 ft. away, the rim drilling and broaching method was not used on this tunnel. All enlarging was done on one side and the top, as shown in Fig. 4.

An improvised drill carriage operating on a standard-gage track, shown in Fig. 5, was used in the enlarging, which was done by ring drilling. The carriage carried columns on which drifter drills were mounted for the side wall drilling. Stopers mounted on a platform on the carriage drilled the crown to 45 deg. from the vertical. Spacing of holes varied with rock conditions, but in all cases was close enough to permit light shooting bringing down the material. The entire tunnel length was drilled before any shooting was done. Muck was loaded with a steam shovel into 12-cu.yd. standard gage cars.

Eliminating the tunnel by an open cut was considered as an alternative, but because of the amount of yardage involved the enlarging was considered more desirable. As a result of the extreme care in shooting the old tunnel, no material was dislodged in the existing cut.

Concrete Lining—The new tunnel and the two enlarged tunnels were lined throughout with concrete, 24 in. minimum thickness in the crown section and 30 in. minimum thickness in the side walls, but no concrete was placed in the inverts. A pneumatic placing machine of 14-cu.ft. capacity per batch placed all of the lining. Specifications called for a 1:2:4 mix in the arch and a 1:2½:5 mix in the sidewalls. Crushed trap rock was used as coarse aggregate. Fiber ducts carrying signal, telephone and telegraph lines were placed in the side walls. Safety niches 3 ft. wide, 12 in. deep and 7 ft. high were placed in the side walls on 50-ft. centers, staggered on each side. A portable mixing plant mounted on a flat car was used on all three tunnels. A railroad crane charged the mixer direct from the material cars. Hopper cars handled by gasoline dinkies conveyed the concrete from the mixer to the placing machine.

Separate wooden forms for sides and roof built up in 24-ft. sections were mounted on trucks riding on the outer rails of the two new tracks. The side walls were poured separately from the arches, and 48 hours' time was allowed after a pour before moving the forms.

Tunnel Plant—Well-equipped shops containing oil furnaces, drill sharpeners and blacksmith outfits were set up at the Garrison tunnel and at the north and south portals of the Breakneck tunnels. Air was supplied by direct-connected diesel-driven compressors, which were moved from the open-cut work to the tunnels as required.

Open-Cut Work—Extreme care to keep the existing main-line tracks clear makes the heavy rock excavation work difficult. Elaborate precautions are taken to insure non-interruption of traffic. At two points, one on each section, adjacent to the largest cuts, temporary cross-

FIG. 7—1¾-CU.YD. STEAM SHOVEL IN NEW BREAKNECK TUNNEL

Note rim-drilling marks on tunnel wall.

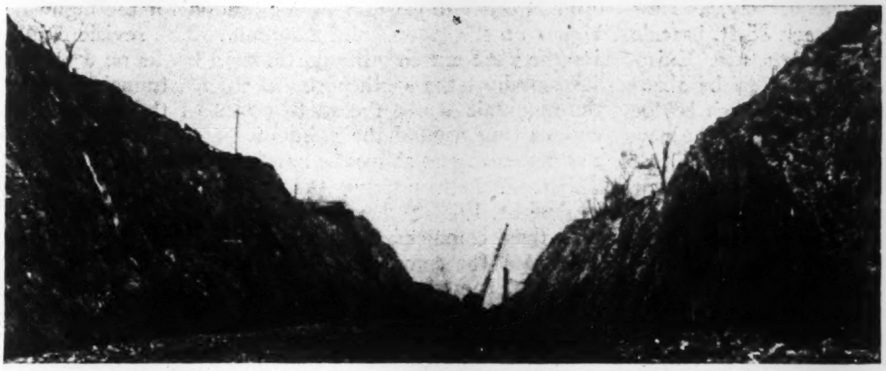


FIG. 8—NEW FOUR-TRACK CUT AT NEW HAMBURG
Crane is setting arch centering for overhead highway crossing.

overs were installed between the two main-line tracks, providing emergency run-arounds for northbound traffic if the track nearest the rock work was blocked. These crossovers are protected by automatic reverse signaling blocks and require temporary interlocking towers at each end. The towermen handle train movements over the crossovers on direct wires to the dispatchers, thus speeding up traffic. All work adjacent to the track is virtually stopped previous to the passing of trains to preclude any possibility of an accident or a blockade. In addition to the crossovers two railroad flagmen and a conductor are on duty at each heavy cut to warn the shovel operators of approaching trains and to assure the safe operation of trains.

Of the two sections, the Garrison-Beacon work involved the greater amount of rock excavation. One cut on this section, just south of Garrison, is more than 5,000 ft. long and required the removal of 450,000 cu.yd. of solid rock. The old cuts had been made in the days before rock cuts were given even a slight sloping bank, so the sides were vertical and in some cases were actually overhanging the northbound track. Much of the excavation on the south section was wasted. On the north section, between Chelsea and Poughkeepsie, the line crosses many small bays and inlets jutting inland from the river. In crossing these waterways and adjacent flats improvements in alignment are being made. A very small amount of excavation on the north section was used in widening fills, the cuts in general balancing the fills up to present. At Camelot, on the north section, part of a new fill across an inlet slid into deep water in the river, so a new cut to carry four tracks is being excavated around the head of the bay, which will require moving about 100,000 cu.yd. of rock. Material from this cut will be hauled by the railroad to make a fill on the line between Barrytown and Tivoli, which will be four-tracked at some future date. Another heavy cut on the north section is at New Hamburg, where an old double-track tunnel will be abandoned in favor of a new four-track open cut (Fig. 8). An advantageous piece of realignment was made at Stoneco by exchanging the old right-of-way of 1½ miles on a curve along the riverbank for a tangent location for four tracks through a stone quarry.

Methods of drilling the cuts vary with the character of the work. Drifter drills mounted on tripods are used for holes more than 20 ft. deep. In more shallow holes hand-handled rotating sinker drills were used. Vertical holes were sunk from the top as deep as possible, the face carried down by benches, and supplementary horizontal holes drilled by tripod drills at the bottom of the deep cuts.

The general procedure followed in excavating the cuts is to work from the ends, carrying the cuts to subgrade as the work progresses. Generally two blasts a day are made, at a time which allows 20 to 30 minutes before trains. Any rock falling on the tracks is removed with the help of locomotive cranes. Heavy steam shovels on crawlers work the end face of the cuts, loading into 12-cu.yd. standard-gage cars alongside or directly behind the shovel on dead-end tracks.

In some places space permits two or more loading tracks. Such cases cut down the switching required, as using but one loading track means every car has to be switched out as loaded. About 400,000 cu.yd. of the total excavation on the south section was wasted, all being dumped in available areas on the east side of the tracks. In some cases switchbacks on 2 per cent grades were necessary to reach the dumps. The longest haul to a dump was about 2 miles. Wasting along the riverbank was impracticable because of the necessity of crossing the main-line tracks with rock trains, and furthermore because dumping rocks on the steep riverbank might, in some places, tend to pull down the adjoining embankment. Part of the excavated yardage on the south section was loaded on 30-cu.yd. cars belonging to the railroad company and hauled away for riprap and embankment filling at other points.

For the larger cuts complete diesel-driven compressor plants, drill sharpeners and blacksmith shops were set up. Portable gasoline-driven compressors were used on the smaller cuts. Repair shops are maintained for the dump cars and locomotives.

Structures—Numerous small bridges, mostly on the north section, had to be extended or replaced by new structures in cases where the alignment was changed.

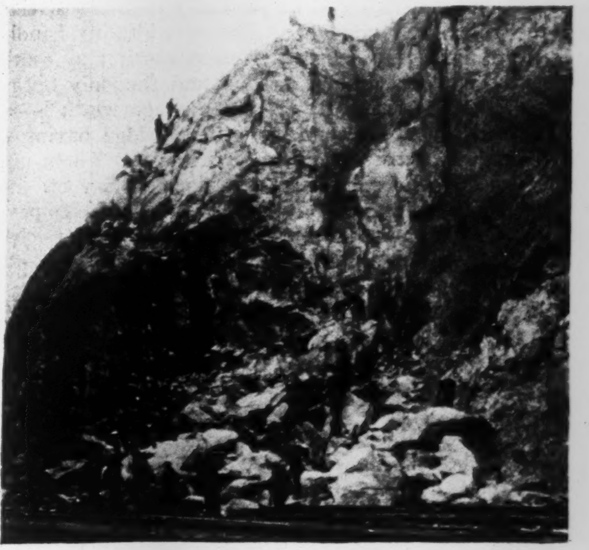


FIG. 9—AFTER A BLAST ON ONE OF THE DEEP CUTS ADJACENT TO THE TRACKS

The largest of these is across Wappinger Bay, at New Hamburg, where the existing double-track 85-ft. bascule span is being supplemented by a similar structure. Existing grade crossings in New Hamburg are to be abandoned in favor of a new overhead concrete arch bridge and a through-girder highway bridge built over the new four-track cut. Pedestrian subways have been built at Garrison, Cold Spring and New Hamburg. Three new interlocking signal towers are being built. Station facilities, sidings and crossovers are being altered to accommodate four tracks.

The New York Public Service Commission had ordered two grade crossings eliminated by overhead bridges at Breakneck Mountain, where a highway at riverbank level runs around the point of the mountain, crossing the tracks near both ends of the Breakneck tunnels. Because riverbank conditions near the south portal of the new tunnel are unsuited for foundations for an overhead structure, the commission has amended the original order to provide a new location for the highway higher up the side of the mountain. The revision calls for the road crossing the northbound tracks on a bridge just south of the south portal of the old tunnel, striking the mountain above the south portal of the new tunnel and passing around the point of the mountain to cross the railroad again above the north portals of both tunnels.

Personnel—Improving the south section commenced in August, 1927, and was finished in April, 1929. Work was then commenced on the north section, which is scheduled for completion late this spring. F. B. Freeman, chief engineer, and J. W. Pfau, assistant chief engineer, are directing the work for the New York Central through E. A. Daugherty, designing engineer, and A. D. Duffie, district engineer, Albany, with T. P. Lynch as resident engineer. The Walsh Construction Co., Davenport, Iowa, is contractor on all excavation, bridge, track and tunnel work, with H. C. Kahl, vice-president, in direct charge.

Knoxville Begins to Carry Out Its New City Plan

Henley St. Widening the First Move in Providing Major Street System Improvement 70 Ft. From Curb to Curb

By Hal H. Hale

Office Engineer, City Engineer's Office, Knoxville, Tenn.

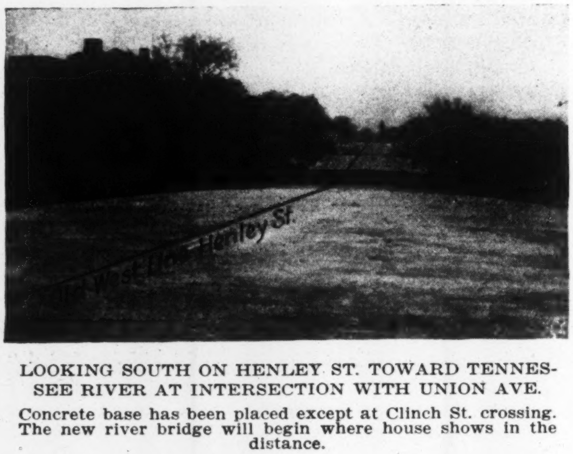
The Henley St. widening is the first major project undertaken conforming with the new city plan of Knoxville, Tenn. The effect of the widening on traffic conditions, centers of business and real-estate values in the business district is problematical, but it is believed that this project is the greatest forward step yet taken toward a well-planned city.

Knoxville has a population of about 140,000. It is located in a mountainous and rolling country, on the banks of the Tennessee River, the city proper being 130 ft. above the water level. Fixed maximum and minimum street grades are impossible. The variation in the business section is from 0.5 to 22 per cent. Narrow streets are the rule, with none of sufficient width to handle present traffic. Gay St. is the main north and south artery through the uptown section and the only outlet south of the Tennessee River. Its average width is 42 ft. between curbs. It connects with a bridge having a 30-ft. roadway across the Tennessee River. There are double-track car lines on both the bridge and Gay St.

During the busiest parts of the day 1,500 vehicles pass through Gay St. in an hour; the total passage for twelve hours averages 11,000, practically all concentrated in one northbound and one southbound lane. With the congestion resulting from such conditions it has long been evident that relief must be had by providing a new north-and-south thoroughfare of ample width, connecting with South Knoxville by a new bridge. The Henley St. widening and the proposed Henley St. bridge are the result. Consideration was first given to widening Broadway, but that was dropped, among other reasons, because its western frontage on property owned and used by the L.& N.R.R. eliminates the use of that side of the street for business purposes.

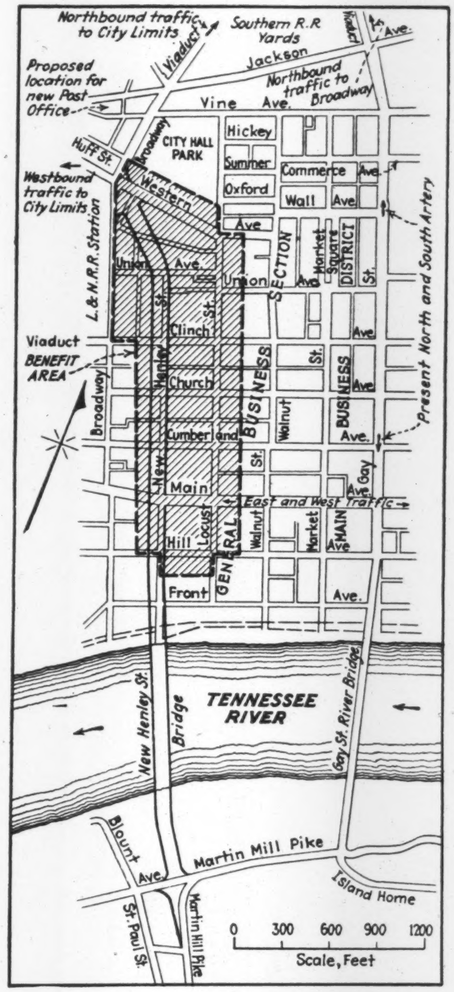
The location of Henley St. relative to the uptown district is shown by the accompanying map. Beginning at Western Ave. and Broadway and extending through to Martin Mill Pike in South Knoxville, the street will connect critical points. Broadway extends to the northern city limits and has a total length of 3½ miles. Martin Mill Pike leads to the southern city limits and the important industrial cities of Alcoa and Maryville, and has a total length of 2.8 miles. In addition to the traffic to and from these two cities, Martin Mill Pike is the western entrance to the new Great Smoky Mountain National Park. Western Ave. is an important east-and-west artery, extending from the western city limits into the business district, with a length of 3 miles. The Western Ave.-Broadway crossing is the heaviest traveled intersection in the city. City Hall Park and the Louisville & Nashville railroad terminal are located at the Western Ave.-Broadway-Henley St. intersection. The tentative location of the new government building is west of Broadway and opposite City Hall Park. The importance of Henley St. as a connecting link in the street system of Knoxville is obvious.

The first official step in the project was the passage of a city ordinance creating the Henley St. Highway Development District, allowing the city to acquire the necessary property for the widening by condemnation. The cost of the property thus acquired and the damages incidental to the work are assessed to a "benefit area" (see map). Each square foot of property within the area bears a



LOOKING SOUTH ON HENLEY ST. TOWARD TENNESSEE RIVER AT INTERSECTION WITH UNION AVE.

Concrete base has been placed except at Clinch St. crossing. The new river bridge will begin where house shows in the distance.

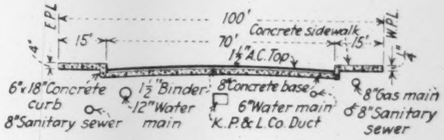

Northbound traffic to City Limits
Viaduct
Southern R.R Yards
Viaduct
Ave.
Jackson
Proposed location for new Post Office
Northbound traffic to Broadway
Vine Ave.
Hickey
Huff St.
Broadway
CITY HALL PARK
Summer
Commerce Ave.
Westbound traffic to City Limits
Western
Oxford
Wall Ave
Ave
L.&N.R.R. Station
Union Ave.
Union
SECTION
Market Square
Ave
DISTRICT
St.
Present North and South Artery
Henley St.
St.
Clinch
Ave
Viaduct
BENEFIT AREA
Broadway
Church
BUSINESS
St.
BUSINESS
Ave
Cumberland
Walnut
BUSINESS
Ave.
New
Main
St.
Gay
Ave.
East and West Traffic
Hill
Locust
GENERAL
Walnut
Market
MAIN
Ave.
Front
Ave.
TENNESSEE RIVER
New Henley St.
Bridge
Gay St. River Bridge
Blount
Ave.
Martin Mill Pike
Island Home
St. Paul St.
Martin Hill Pike
0 300 600 900 1200
Scale, Feet

HENLEY ST. WIDENING PROJECT, KNOXVILLE, TENN.

proportionate share of the damages and widening costs.

The next step was to create a highway improvement district, to cover the necessary paving, sidewalks, sewers and water mains. This form of improvement is known as "one-fourth-three-fourths plan," the city bearing one-fourth and property owners three-fourths of the cost of paving, curbing, sewers and grading. For this each foot of street frontage in the district is assessed the same proportionate share of the cost of the improvement regardless of depth or location. The entire cost of sidewalks, sewer and water connections is borne by the property owners served. If the total assessment for the improvement exceeds 50 per cent of the valuation of any parcel of land, as determined by the tax assessment on the parcel at the time of creation of the district, the excess amount is assumed by the city at large, the assessment against the parcel becoming half of the assessed valuation. The cost of water mains is borne by the city.

When completed, Henley St. will be 70 ft. wide between face of curbs, with two 15-ft. sidewalks. The paving will be 1½ in. of sheet asphalt and 1½ in. of binder, on an 8-in. concrete base. The length of the widening district is 2,500 ft.; the length of the proposed bridge, including approaches, is 2,070 ft.; the total length of the project is 4,570 ft. It was found most economical to lay dual sewer and water lines, but gas, telephone and electric service have one line each.


E.P.L.
100'
Concrete sidewalk
W.P.L.
15'
70'
15'
4"
1½" A.C. Top
4"
6"×18" Concrete curb
8" Sanitary sewer
1½" Binder
12" Water main
8" Concrete base
K.P.&L. Co. Duct
6" Water main
8" Gas main
8" Sanitary sewer

TYPICAL SECTION HENLEY ST. WIDENING

Because of the rolling nature of the ground through which the improvement is being made, extensive reinforced-concrete construction was necessary along the west property line of Henley St. Cantilever retaining walls varying from 7 to 24 ft. in height and the rebuilding of 225 ft. of the Clinch Ave. viaduct are a part of the concrete work. The rebuilding of the viaduct will eliminate a 12 per cent grade in the western approach to Henley St. with a resulting grade of 1.4 per cent. The maximum approaching grade to Henley St. is on Cumberland Ave. from the west. This grade will be 9.8 per cent. The maximum grade of the new Henley St. will be 6 per cent and the minimum 1.8 per cent.

The entire project involves 35,000 cu.yd. of earth excavation at a contract price of 40c. per yard and 36,000 sq.yd. of paving at $1.96 a square yard.

Construction work on the paving district proper was begun Jan. 18, 1929, and completed Jan. 4, 1930. The contract for the new Henley St. bridge is to be let in the summer of 1930 and will require two years to complete. The full effect of the improvement will necessarily await the completion of the bridge.

All work is being done under the direction of Walter W. Mynatt, director of public service, under the immediate charge of Harry J. Wight, city engineer. Roy I. Gentry is resident engineer of construction for the city. The Murray Construction Company, of Knoxville, is general contractor. The new city plan followed the adoption of a city-manager charter in 1923, which created a city planning commission. In 1926 the commission employed Harland Batholomew & Associates, St. Louis, Mo., to draft a plan. The first report of this organization, about a year later, presented a major street plan, with which the Henley St. widening project is in general agreement.

LOOKING WEST ON CLINCH ST. FROM NORTHEAST CORNER OF HENLEY ST.
Reconstruction of Clinch Ave. viaduct, in progress, will eliminate a 12 per cent grade from approach to viaduct. Latter spans L.&N.R.R. yards.

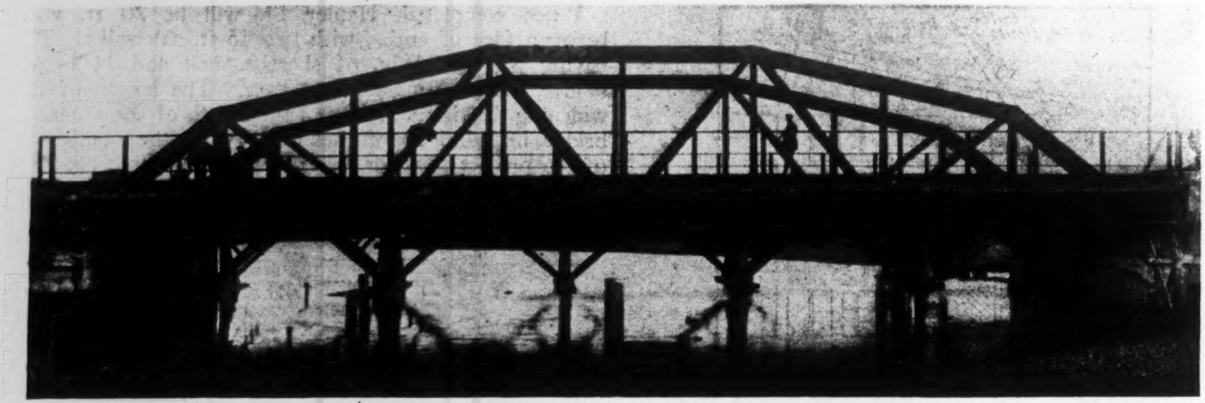


FIG. 1—ARC-WELDED HIGHWAY BRIDGE IN EUROPE
Falsework is still in place.

The First Arc-Welded Bridge in Europe

Through-Truss Highway Structure of 88½-Ft. Span Built for Polish Government—All Members Built Up of Plates, Channels and Angles, Using Flux-Covered Electrodes With 180-Amp. and 30-Volt Current

By Stefan Bryla
Professor of the Technical University, Lwow, Poland

The first arc-welded steel bridge in Europe has been erected for the Polish government in Lowicz, Poland, and crosses the Sludwia River in a single span 88½ ft. between supports. It is located on the principal state highway between Warsaw, Poznan and Berlin. The total width of the bridge is about 32 ft. 9 in. and the distance between the trusses is 20 ft. 4 in. Sidewalks 6 ft. wide are cantilevered out on either side.

The design calculations were made in compliance with the specification of the Polish Ministry of Public Works, issued in 1925. The material used in the bridge is mild steel with an ultimate strength of 55,000/60,000 lb. per sq.in. and with a minimum elongation of 20 per cent. The allowable unit stresses were 16,000 lb. per sq.in. for the trusses and about 12,000 lb. per sq.in. for the floorbeams and stringers. Mild steel electrodes with an ultimate strength of 55,000/60,000 lb. per sq.in., containing a minimum of 0.1 per cent carbon and 0.25 per cent manganese, were used. Elongation, bend and shearing tests were required of all welders.

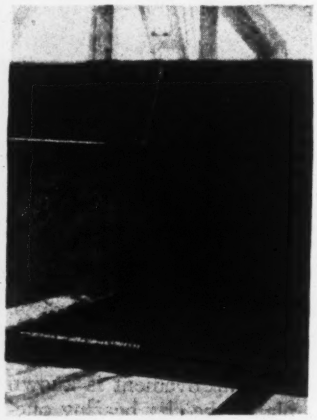


FIG. 3—WELDED CONNECTION BETWEEN STRINGER AND FLOORBEAM
Adoption of this type of connection permitted calculation of the stringers as continuous beams and resulted in a saving of about 12 per cent of steel in the crossbeams.

FIG. 2—WELDING AN END POST ON THE POLISH HIGHWAY BRIDGE
Note the welding generator in the foreground.

Details of the Bridge—The trusses of the bridge are of camel-back outline, having a span of 88½ ft. and a height in the middle of 14 ft. All members of the trusses are built up of plates, channels and angles, as shown in the accompanying drawings. The chords are built up entirely of plates. The diagonals consist of two channels turned to the outside and joined with coverplates top and bottom, while the vertical members are made up of a single plate and four flange angles. The crossbeams are plate girders constructed entirely of flat plates with no flange angles.

I-beams are used as longitudinal stringers and are welded to the cross-girders by trapezoidal plates, not only for the purpose of connection but also to stiffen the web of the cross-girders. This detail, shown in Fig. 3, permitted the calculation of the stringers as continuous beams on elastic supports. While the elasticity of the supports diminishes the advantage of continuity, it draws the crossbeams into co-operation and allowed a saving of 12 per cent in the material of the crossbeams. However, this saving is possible only if there are one or two concentrated loads sufficiently large in comparison with the other loads, a contingency foreseen by the Polish specifications.

All the welds of the plates are butt welds. In the calculations it was assumed that these welds had only 75 per cent of the resistance of the base material. The wind bracing consists of angles welded to horizontal gussets which are attached to the lower chords of the main trusses and to the crossbeams.

Building the Bridge—Pieces up to 23 ft. long were welded in the shop. Special jigs (Fig. 6) were used at about 3-ft. intervals to hold the pieces firmly together. In one instance these jigs consisted of $\frac{3}{4}$-in. round bars bent according to the cross-section of the pieces to be welded. Two gussets were welded to the inside of these bars with a crack of about 2 in. left between the gussets. The width of this crack was regulated by means of two angles in such a way as to admit the vertical plates of the bridge member with close clearance.

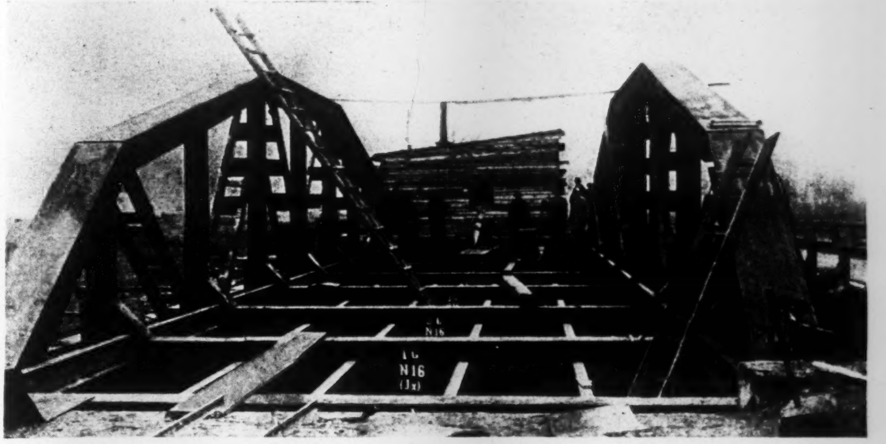


FIG. 4—WELDED HIGHWAY BRIDGE IN POLAND NEARING COMPLETION

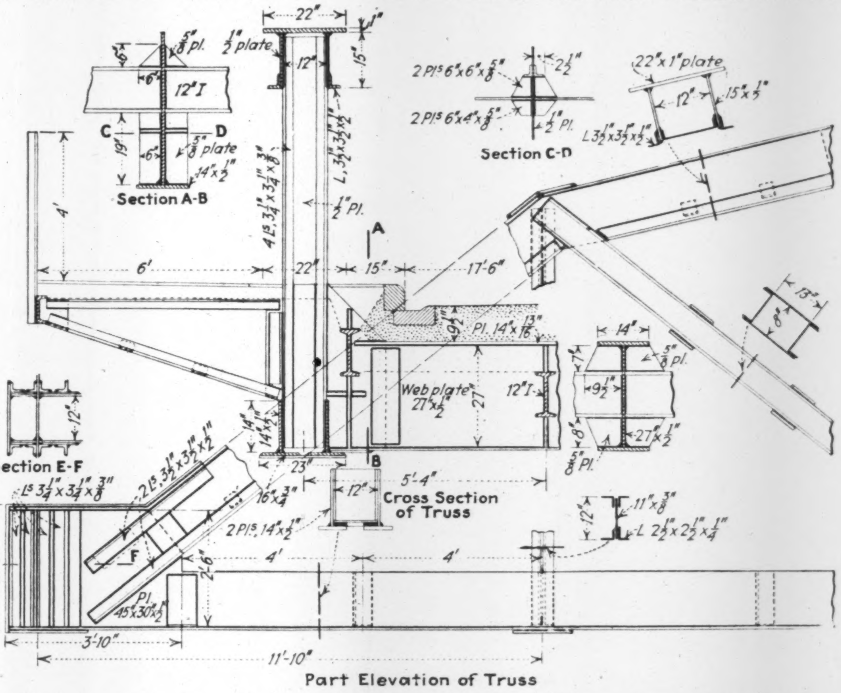

22"
1"
5/8" pl.
1/2" plate
12"
15"
6"
12" I
C
D
19"
6"
5/8" plate
14"x1/2"
Section A-B
4'
6'
4 Ls 3 1/4"x3 1/4"x3/8"
L, 3 1/2"x3 1/2"x1/2"
1/2" Pl.
2 Pls 6"x6"x5/8"
2 1/2"
2 Pls 6"x4"x5/8"
1/2" Pl.
Section C-D
22"x1" plate
12"
15"x1/2"
L 3 1/2"x3 1/2"x1/2"
A
22"
15"
17'-6"
9 1/2"
Pl. 14"x13/16"
Web plate 27"x1/2"
27"
12" I
14"
7"
5/8" pl.
9 1/2"
8"
27"x1/2"
5/8" Pl.
13"
8"
12"
Section E-F
14"x1/2"
14"
23"
B
Ls 3 1/4"x3 1/4"x3/8"
2 Ls 3 1/2"x3 1/2"x1/2"
16"x3/4"
12"
5'-4"
Cross Section of Truss
2 Pls 14"x1/2"
11"x3/8"
L 2 1/2"x2 1/2"x1/4"
12"
E
2'-9"
F
2'-6"
4'
4'
Pl. 45"x30"x1/2"
3'-10"
11'-10"
Part Elevation of Truss

FIG. 5—STRUCTURAL DETAILS OF WELDED HIGHWAY BRIDGE IN POLAND

In the jig for the upper chord, which has a double-T section, channel spacers were placed between the vertical plates of the chord. Between the gussets and the flanges of these channels a crack about 1 in. wide was left to permit free access of the electrode.

The vertical members, consisting of a plate and four angles, were assembled by the aid of two screws on both ends and some short welds along each vertical. The two channels of the diagonal members were assembled by means of plates cut as shown in Fig. 6D. The cross-girders were constructed by the aid of the jigs shown in Fig. 6C and similar to those employed for the chords.

Current of 180 amp. and 30 volts was used in the field. Hand welding was resorted to, utilizing flux-covered electrodes. Assembling in the field was done on a temporary wooden trestle, all of the steel being erected by means of a wooden crane. The work began by placing the floor of the bridge and later the main trusses. Three welders were employed in the field.

The design of the bridge was executed by the writer, who also had supervision of the construction and erection. The total weight of the bridge is 55 tons, while the riveted design would have weighed 70 tons. Unfortunately there was not an equal saving in the cost of the bridge, because the amortization of the cost of the necessary arc-welding machines had to be included in the cost of the bridge. As a consequence the arc-welded bridge cost approximately as much as a riveted bridge. Nevertheless, the writer is firmly convinced that in the course of time the proportion of costs of the two types of bridges will be changed in favor of the arc-welded design.

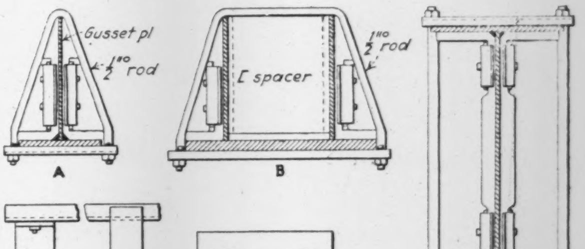
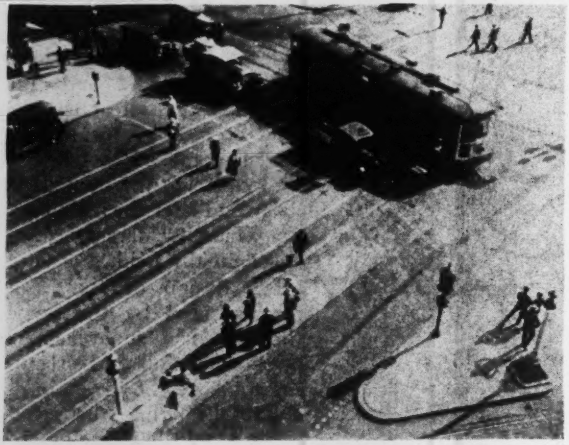

Gusset pl
1/2" ro rod
A
[spacer
B
1/2" ro rod
C
D

FIG. 6—JIGS USED IN FABRICATING MEMBERS FOR WELDED BRIDGE IN POLAND

Separate Signals for Pedestrian Traffic in San Francisco

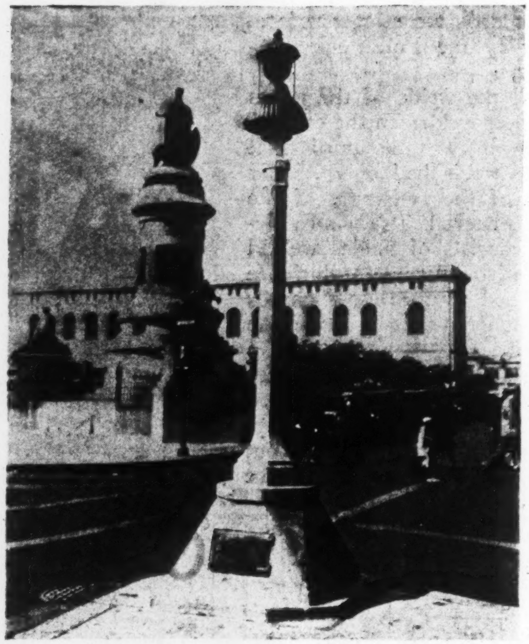
Crosswalks at Complicated Intersections Have "Go-and-Stop" Signals for Pedestrians—Safety Islands Lighted

TRAFFIC signals exclusively for pedestrians are the unusual feature recently introduced as another step toward the efficient control of the complicated traffic situation on Market St., San Francisco. These signals are a part of the new progressively timed control system resulting from several years of intensive study of the problem. Announcement of the new traffic code adoption appeared in *Engineering News-Record*, May 10, 1928, p. 749, and the traffic-engineering problems encountered in the business district were outlined in the issue of Oct. 11, 1928, p. 536. The new pedestrian signals and the floodlighted safety islands are described in the following.



PEDESTRIAN MOVEMENT CONTROLLED BY SIGNAL
The two types of signals appear at the ends of the crosswalk. Note safety island with beacon standard.

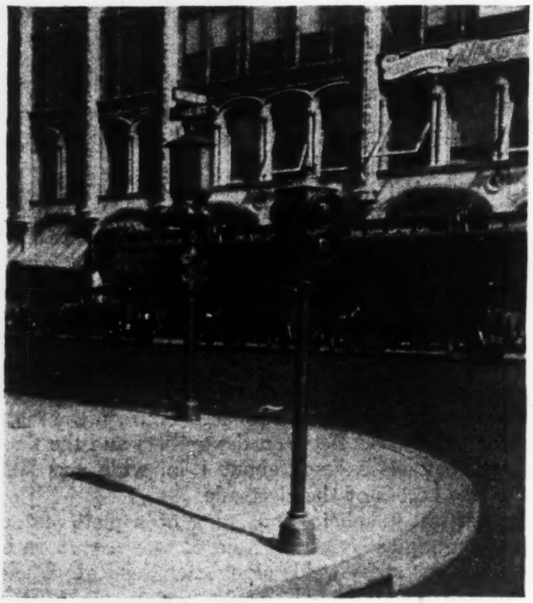
Irregular intersections and long crosswalks common on Market St. make it impossible, in many locations, to provide signals for vehicular traffic that also can control pedestrians. This difficulty resulted in the innovation of providing separate traffic signals to direct the movement of pedestrians across the intersections. The signals consist of a pipe standard surmounted by a box containing red and green lights pointed in the direction of the crosswalk traffic. The lights are synchronized with the progressive timing system which actuates the vehicular signals. In addition to these pedestrian signals, many of the "birdcage" type of vehicular signals in common use in San Francisco were equipped with a set of pedestrian signal lights placed beneath the vehicular signals, thus permitting each standard to perform dual service. The two types of signals and their relative positions are shown in the accompanying illustrations.



WARNING BEACON ON SAFETY ISLAND
The floodlight is topped by a yellow flashing warning for motorists.

As now operating, the pedestrian signals show a red light at the crosswalks during the period when vehicular traffic is moving across the walk. The light continues red until the vehicular signal parallel to the crosswalk indicates "go," at which instant the pedestrian light changes to green. Thus pedestrian traffic is warned off the intersection not only during the movement of vehicular traffic but in addition during the period when the intersection is clearing. Because of the long intersections, a clearing period of fifteen seconds is required in some cases. This causes long delays for pedestrians, but is considered necessary from the standpoint of safety.

The number of pedestrian signals required to provide complete control over all crosswalks is unusually high because of the complicated five-way intersections and the numerous side streets dead-ending at Market St. The five-way intersections are equipped with seven pedestrian signals and in addition require eight vehicular traffic signals. More than 180 exclusive pedestrian signals have been installed and the system is not yet completed.



SEPARATE PEDESTRIAN SIGNAL AT CROSSWALK
Combined signal in background controls both vehicular and pedestrian traffic.

The large area intersections, in some cases necessitating crosswalks 300 ft. long, were provided with another safety feature by the introduction of safety islands for pedestrians. These are particularly important when a change of signals occurs as pedestrians are in the center of a long intersection. The islands are isolated sections of sidewalk elevated to the usual curb height and are equipped with pedestrian signals to regulate the traffic to and from them. To improve the safety of these islands after dark when the traffic signals are not operating and vehicular speeds are high, they are floodlighted. The source of this illumination is in a substantial concrete shaft located on the island which carries above the floodlight a yellow flashing beacon. The floodlight makes pedestrians plainly visible and the flashing signal serves as a warning to approaching motorists even over the top of a preceding car.

The new signals and the progressive timing system were set in operation on Sept. 11, and details are being improved gradually as the installation is completed and further studies indicate the advisability of slight changes in the scheme. The new system has been worked out under the direction of George Burr, city traffic engineer, under the general supervision of M. M. O'Shaughnessy, city engineer of San Francisco.

Observations on the Flood Disaster in Southern France

By Carl Hanns Pollog
Basel, Switzerland

NEWS of the disastrous floods in southern France has been published by the daily press and a short résumé was also given in the March 13 issue of *Engineering News-Record*. The principal items of this latter have not been appreciably altered by later news, except of that the number of deaths probably will not be as high as indicated there.

After a rapid survey of the loss of life and property had been made by the local authorities, the French government recently published a decree limiting the zone which is to be considered as devastated area with regard to the legal and other relief measures, and gave out some statistical figures, which follow:

Department	Area Inundated, Hectares	Houses Destroyed	Persons Killed
Aude	24,180	119	1
Aveyron	3,050	16	...
Corrèze	3,020	....	...
Dordogne	3,191	....	...
Gironde	14,000	38	...
Haute-Garonne	600	416	6
Hérault	16,025	14	...
Lot-et-Garonne	40,000	91	7
Pyrénées-Orientales	2,215	2	...
Tarn	8,500	297	...
Tarn-et-Garonne	28,219	1,700	186
Total	143,000	2,693	200

The loss of livestock was about 10,000 head, more than 7,000 of which was in Tarn-et-Garonne. Figures for persons killed, as given above, are not final, as a few days after the publication of the official records four other corpses were discovered. Nevertheless the first evaluations which gave 400 deaths for Tarn-et-Garonne alone have proved exaggerated.

It is true that very little has been done with regard to the regulation of rivers in southern France, as carelessness and short memory are characteristic traits of the French of the south. Therefore, local floods and inundations occur nearly every spring and are rapidly forgotten. But last winter there was a precipitation well above the average, and especially on the Mediterranean slope, where weeks of heavy rains preceded the disaster. Immediately before the beginning of the floods, for example, at Perpignan 135 millimeters of rain fell within 24 hours. And because of the high temperatures this precipitation fell in form of rain even in the higher altitudes, causing a rapid melting of the heavy snow cover in the Pyrenees and the Massif Central. This coincidence is the cause of the suddenness and the extreme disastrousness of the floods. It is reported that the level of a small river rose nearly 35 ft. during a single afternoon, and nearly everywhere the floods were by far the highest on record, surpassing all gages on record by from 3 to 6 ft.

Under these circumstances it will be easily understood that the few dikes and control works existing were of little or no use. For example, when control works were built near the mouth of the River Orb shortly after the war, the highest floods hitherto on record, those of 1856 and 1875, were taken into consideration, and in all construction work a safety margin of 5 ft. was added, yet this was surpassed by 3 ft. The situation was very often still further aggravated by fragments of houses, bridges, etc., that were swept away, obstructing and damming up the generally rather narrow river channels.

As in the case of previous floods, much has been spoken and written in France during these weeks of the terrible effects of deforestation and of the immediate need of an extensive reforestation program. But it is doubtful whether these discussions will have any considerable effect. Deforestation has been the calamity of France, especially of her southern parts, for many centuries. When Cæsar conquered Gaul in the sixth decade B.C., it was a densely wooded country, but today only 18.9 per cent of the area of France is covered with woods, and the devastated departments show figures below, some far below, the average. It must also be borne in mind that what is officially classified as wood very often is merely brush and, in the Mediterranean region, evergreen macchia. Thus there is nothing to prevent a dangerously rapid run-off of the rain or snow water.

The deforestation and its eventual consequences have been complained of already by French writers of the sixteenth and seventeenth centuries, but it has been accelerated in the last and current centuries. This has been caused partly by the inheritance laws introduced by the Great Revolution, under which after the death of a landowner it is very often necessary for the heirs to get cash quickly, which is most easily obtained by cutting some plot of forest. In part also it is due to the ever-diminishing readiness of man generally to care for the second or third generation.

Under these circumstances reforestation will be no easy task. Only a very small portion of the country where reforestation is necessary is state owned; the rest belongs, often in ridiculously small patches, to an immense number of private owners. The experiences of the existing local forest boards which distribute seeds free of charge and give advice regarding reforestation problems are not very encouraging: their services are scarcely demanded by anybody. On the other hand a reforestation program must be broadly conceived and realized; it will not do for one landowner to reforest and his neighbor to cut down. And under the most favorable circumstances a reforestation program would not begin to have much effect on the water run-off of a whole region for perhaps half a century!

Modernizing the Widest Business Street in America

Canal St. in New Orleans Completely Rebuilt for Distance of Fifteen Blocks—Terrazzo Top Used on Sidewalks and 58 Ft. Neutral Ground in Center of Street—New Street-Car Track Design to Eliminate Pavement Cracking

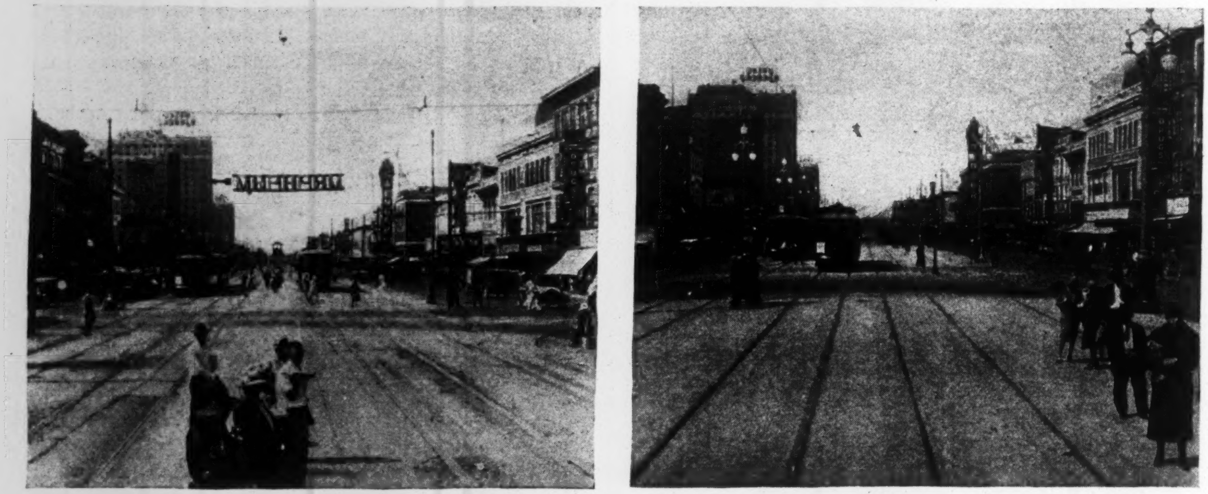


FIG. 1—CANAL ST., NEW ORLEANS, BEFORE AND AFTER MODERNIZATION
In right hand view neutral ground, occupied by the car tracks, is paved with pink and white terrazzo. A similar finish is used on the sidewalks.

NEW ORLEANS presented a rejuvenated Canal St. to the Mardi Gras visitors this year. Between Nov. 15 and March 1 one of the most elaborate and unusual municipal paving jobs ever undertaken was begun and completed by the city engineer, Bryson Vallas. Few if any thoroughfares in the world are 170½ ft. wide between property lines, and none can boast a terrazzo finish (similar to that found in the entrance halls of the best office buildings) on the sidewalks and over a 58½-ft. strip in the center of the street. Yet that is just what Canal St. now presents for a length of fifteen blocks, from the Mississippi River northward to Claiborne Ave. It also lays claim to being one of the best-illuminated streets in the world, following the installation of an elaborate system of lighting standards. In the center of the street, too, are four lines of street-car tracks resting on a novel foundation, including flexible diaphragms in place of crossties and so designed that none of the loads from the cars will be transmitted to the surrounding pavement. The terrazzo center strip is flanked by two 35-ft. roadways of sheet asphalt on a concrete base. A finishing touch is added by providing facilities for fencing off parades and for mounting flags and decorations.

The reason for this elaborate pavement display is obvious to anyone familiar with New Orleans. It is, among other things, a tourist city, a city for conventions and festivals. And Canal St. is New Orleans' show window. All of its principal retail shops are located on or just off of Canal St. Many parades pass over the street annually. It is a huge convention hall during Mardi Gras. Every street car in the city (with the exception of a few on crosstown lines) is routed over the lower nine blocks of Canal St. It is practically true that every resident and every visitor must necessarily be on Canal St. during some part of the day.

In spite of the importance of this main street, its appearance during the past few years has not been a very good recommendation for the city. The present modernization program is a result of a realization of this fact on the part of city officials, merchants and the New Orleans Public Service, Inc. The latter company paid the entire cost of the track reconstruction and the center strip paving, while a large share of the roadway paving and sidewalk construction costs was charged to the abutting property owners.

New Street-Car Tracks—Reconstruction of the car tracks occupying a wide strip in the center of the street, as shown in Figs. 1 and 4, was the first operation. This strip is known locally as the neutral ground, because it has never been used for roadway purposes. It was originally owned by a canal company that planned to dig a canal connecting the Mississippi River with Lake Pontchartrain, but court action restrained actual construction and in 1842 the area was adjudicated to the city. In the meantime roadways had come into use on either side of the neutral ground. Later these roadways were improved and street-car tracks installed on the neutral ground, which then became merely a loading platform for the street cars. That is its sole use today. Incidentally, it is absolutely necessary to have such a loading platform, because 27 car lines discharge and load along the lower nine blocks of Canal St.

From Rampart St. to the river, a distance of nine blocks, there are at present four lines of tracks, while from Rampart St. northward to Claiborne, the end of

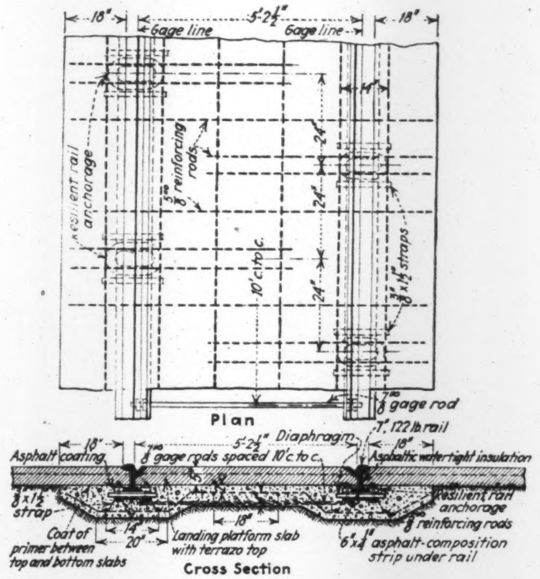

18"
5'-2½"
Gage line
Gage line
18"
14"
Resilient rail anchorage
⅝" reinforcing rods
24"
24"
24"
10' c. to c.
⅜" x 1½" straps
⅞" gage rod
Plan
7", 122 lb. rail
18"
5'-2½"
Diaphragm
18"
Asphalt coating
⅞" gage rods spaced 10' c. to c.
Asphaltic water-tight insulation
⅜" x 1½" strap
Resilient rail anchorage
⅝" reinforcing rods
18"
14"
20"
Coat of primer between top and bottom slabs
Landing platform slab with terrazo top
6" x ¼" asphalt-composition strip under rail
Cross Section

FIG. 2—DETAILS OF RESILIENT TRACK CONSTRUCTION FOR NEW ORLEANS STREET RAILWAY

the present reconstruction, there are two tracks. The new track construction has been developed by the New Orleans Public Service, Inc., and is novel in many particulars. Briefly, it consists of a reinforced-concrete foundation in which the rails are anchored by resilient rail anchorages. The concrete foundation is shaped to form a continuous girder beneath each rail, and is reinforced with ⅝-in. bars. The foundation mat replaces the conventional crossties.

The resilient rail anchorage is made up of two oval-shaped thin steel plates, the outer edges of which are crimped over a round steel ring and welded to form a closed container or diaphragm. A hot asphalt-asbestos mixture is forced into this diaphragm under pressure. Oval-shaped bearing plates are welded to the top and bottom of the diaphragm. The rail, a 7-in. A.E.R.A. girder section, is held in place by rail clips, the anchorage bolts passing through the diaphragm and also through longitudinal angles which space the diaphragms along the track. There are two of these continuous longitudinal angles parallel and beneath each rail. The angles are held in alignment by transverse straps welded to the angles, one on either side of each diaphragm. Hooked ends on these straps support the entire system of bar reinforcement. Details of the track construction and of the diaphragm are shown in Figs. 2 and 5.

FIG. 3—LARGE FORCES OF WORKMEN WERE NECESSARY TO COMPLETE THE RECONSTRUCTION OF CANAL ST. BEFORE MARDI GRAS

Writing in the *Electric Railway Journal* for March, I. O. Mall, assistant superintendent of roadway, New Orleans Public Service, Inc., explains this system of track construction as follows: "The load from the rail is transmitted through the upper bearing plate to the top of the diaphragm. As the diaphragm plate flexes inward a compression is built up in the confined asphalt-asbestos cushion and this pressure is reacted to by the bottom bearing plate of the diaphragm, which in turn transmits the load to the foundation. When the load is relieved, the residual compression in the cushion, acting in conjunction with the resilient diaphragm plates, returns the upper bearing plate to its normal position. The asphalt-asbestos cushion serves a dual purpose in that it affords stability to the diaphragm and aids in dissipating the vibration absorbed from the rail."

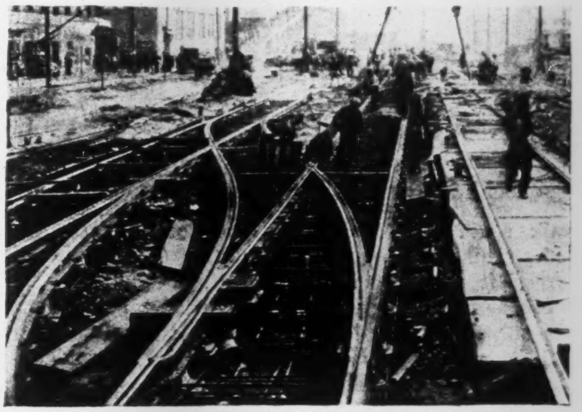


FIG. 4—NOVEL TRACK CONSTRUCTION ELIMINATES CROSSTIES

Resilient anchorages are placed at 4-ft. intervals along the rails and concreted into a foundation slab which takes the place of crossties. Rails are separated from the foundation slab and from the top slab by coating them with asphalt.

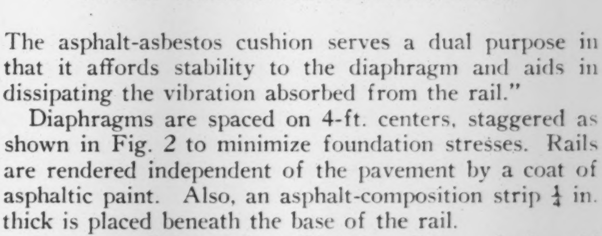

Continuous angles in concrete foundation
Top bearing plate
Diaphragm crimped over round steel ring and welded
Asphalt-asbestos mixture
Bottom bearing plate
1½" x ⅜" strap for foundation anchorage and reinforcement support

FIG. 5—DETAILS OF DIAPHRAGM AND ANCHORAGE IN NEW ORLEANS TRACK CONSTRUCTION

Diaphragms are spaced on 4-ft. centers, staggered as shown in Fig. 2 to minimize foundation stresses. Rails are rendered independent of the pavement by a coat of asphaltic paint. Also, an asphalt-composition strip ¼ in. thick is placed beneath the base of the rail.

Roadway Construction—The demolition of the old roadway began soon after work was under way on the neutral ground. The old cross-section consisted of two 37-ft. roadways and two 18-ft. sidewalks. More side-

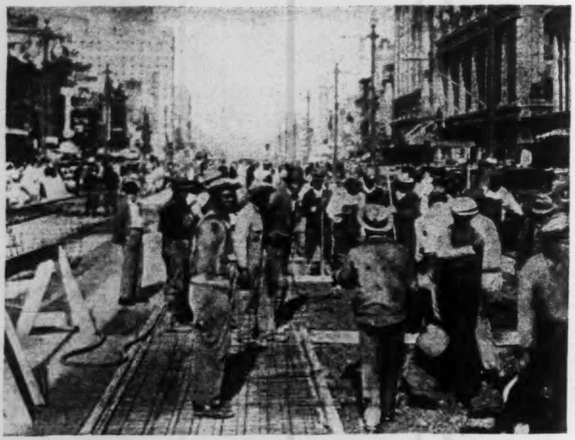


FIG. 6—PLACING DRY CONCRETE AS BASE FOR COLORED TERRAZZO TOP

walk space was needed to care for the crowds of pedestrians, and the new cross-section (Fig. 7) provides two 35-ft. roadways and two 21-ft. sidewalks.

High-early-strength cement was used for all concrete, not only in the roadway but in the track foundations, and concrete proportions were the same as would have been usual with standard portland cement. The roadway base consists of an 8-in. slab of 1 : 2½ : 5 concrete. All concrete was centrally mixed and hauled in flat-bottom trucks. A 2½-in. slump was specified. Tarpaulins were placed in the bottoms of these trucks so that the concrete would slide out easily. The average haul was about ¾ mile, and the maximum haul about 1½ miles.

The wearing surface of the roadways is 3 in. of 30-35 penetration sheet asphalt, made up of a 1½-in. binder course utilizing slag aggregate binder and a 1½-in. wearing surface utilizing limestone filler and a combination of fine Mississippi River and coarse Lake Pontchartrain sand.

The new curbs are of Georgia granite, 6 in. thick and 18 in. deep. An unusual feature is that they rest on piers 1 ft. wide, which were poured monolithic with the roadway base. Gutter bottoms were also formed at the same time that the pavement slab was poured.

Neutral Ground and Sidewalks—The construction of the sidewalk and the top slab of the neutral ground followed similar practice, hence only the neutral ground will be described. The total thickness of the slab is 5 in., including the 1-in. top of terrazzo. This 5-in. slab is separated from the track foundation by a coat of primer to prevent bond. As previously stated, the rails are covered with an asphalt coating so that this top slab, which serves only as a loading platform, is entirely separated from the track construction.

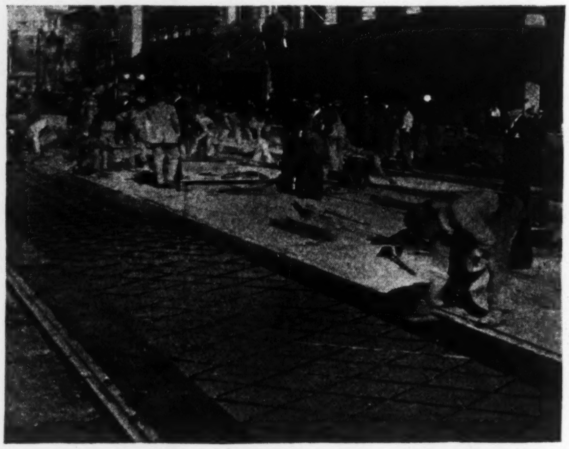
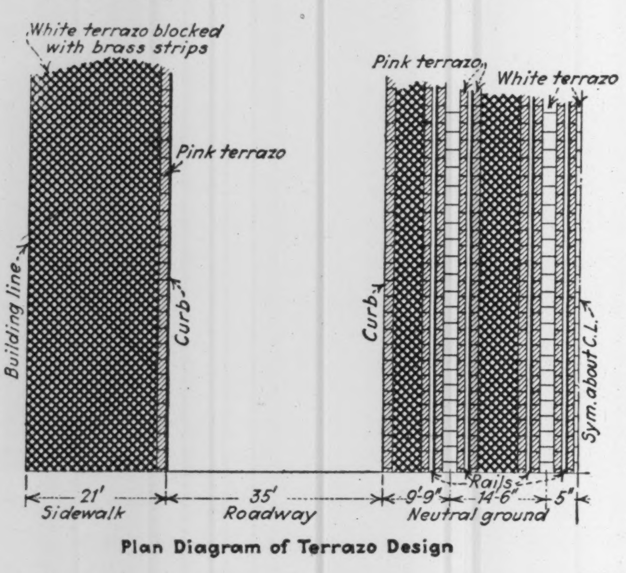


FIG. 8—TERRAZZO TOP, NEUTRAL GROUND, CANAL ST., NEW ORLEANS

Diamond-shaped blocks of terrazzo are formed by brass strips. Borders are pink terrazzo.

The architectural design of the terrazzo is interesting and an idea of it may be gained from Figs. 7 and 8. The diamond-shaped blocks are formed by brass strips 1 in. deep, and similar brass strips run longitudinally along the edges of the borders. These border strips, which are used on either side of each rail, back of the curbs on the sidewalks and on the neutral ground, and on either side of the crosswalks in the neutral ground, are of pink terrazzo; the finish within the diamond-shaped blocks is white.

Because of the pink coloring in the borders, it was necessary to use a very dry mix in the base course; a mix even normally wet was found to wash the coloring.


White terrazo blocked with brass strips
Pink terrazo
Pink terrazo
White terrazo
Building line
Curb
Curb
Sym. about C.L.
Rails
21'
Sidewalk
35'
Roadway
9'-9"
14'-6"
5"
Neutral ground

Plan Diagram of Terrazo Design

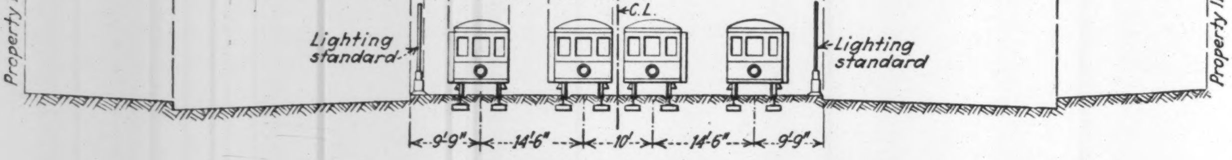

170'-6"
21'
Sidewalk
35'
Roadway
58'-6"
Neutral ground
35'
Roadway
21'
Sidewalk
Property line
Property line
23"
2'10"
9'-4"
5'-2"
9'-4"
8"
C.L.
Lighting standard
Lighting standard
9'-9"
14'-6"
10'
14'-6"
9'-9"

FIG. 7—CROSS-SECTION OF CANAL ST., NEW ORLEANS

A ½-in. slump was specified, and special attention was paid to tamping. A 1:3:6 mix was used. As soon as the base had acquired its initial set, the brass strips were installed, being held upright by a little mortar when this was necessary. In terrazzo floor construction in buildings, each side of the square is a separate brass strip. A method of mortising the long strips was developed on this paving job, so that when the brass strips were all installed, they formed a fairly rigid grid or mat which did not move under finishing and rolling operations.

For the terrazzo top, mica feldspar and Georgia marble, the latter in ¼- and ½-in. sizes, were used for aggregate. The mica feldspar, the ½-in. marble particles and the cement were mixed with hoes in steel mortar boxes. This mixture was placed by hand, as shown in Fig. 6, after which the ¼-in. marble particles were sprinkled on top, followed by light rolling and troweling. The finishing was done with electric carborundum machines, using as coarse a grinding stone as possible so as not to produce a slippery surface. Sand and water in considerable quantities were required as cutting and lubricating agents. The topping set up sufficiently in 48 to 60 hours to permit the finishing machines to commence work.

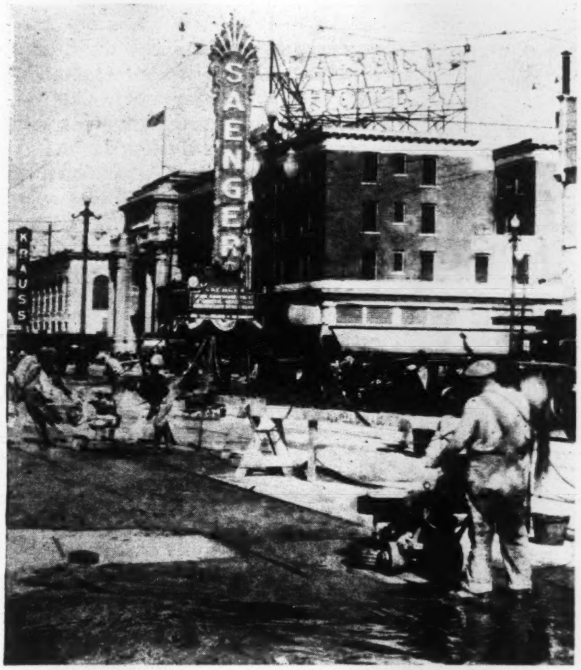


FIG. 9—ELECTRIC CARBORUNDUM GRINDING MACHINE ON TERRAZZO FINISH OF CANAL ST., NEW ORLEANS

Construction of the pink borders was carried out in a similar manner. The pink color was obtained by using 7 per cent of iron oxide by weight of the cement. The iron oxide and cement were mixed dry before water or aggregates were added. Also, in these border strips Georgia pink granite was used, the largest particles of which were about ¼ in.

Lighting Poles and Other Facilities—New lighting standards have been installed at 100-ft. intervals along each side of the neutral ground. Three globes are used on each standard, and are shaped to simulate magnolia blossoms. Each light has a capacity of 1,000 watts, but is wired for 2,000-watt lights if these should ever be wanted. The shafts of the standards are fluted, and the tops are decorated in relief with oleander leaves and blossoms, the official city flower. On the sides of the square base are bronze seals of Spain, France, the Confederacy and the United States, the four governments that have been dominant at different times in New Orleans.

Because of the many parades that are held in New Orleans, the new street construction provides several novel facilities to assist in handling the crowds at such times. Rings are placed on the lighting standards, through which cables can be threaded. Also, sockets, normally covered with brass plugs, are placed half-way between lighting standards so that posts can be set as additional support for the cables. Corresponding sockets are provided along the sidewalk curb, so that a complete system of cables can be quickly and easily erected which will keep the crowds on the sidewalk or in the neutral ground. Along the sidewalk curb smaller sockets are placed every 20 ft., to hold the merchants' flag poles.

Costs—The total cost of the paving was $612,000, divided $41,000 for drainage, $321,000 for roadways and $250,000 for the neutral ground and the sidewalks. Of the drainage cost, the city paid $10,000 and the property owners $31,000. Of the paving cost, the city paid $60,000 and the property owners $261,000. Of the sidewalk cost, the city paid $16,000 and the property owners $42,000. The cost of the neutral ground area construction was $192,000 and was paid for by the New Orleans Public Service, Inc. This latter figure does not include the cost of track construction.

Some of the costs per square yard were as follows: white artificial stone sidewalk, $5.65; colored artificial stone sidewalk, $5.95; asphalt, $1.45; 8-in. concrete base under roadway, $3.15.

Chemical Used to Thaw Fire Hydrant

Frozen fire hydrants in Evanston, Ill., have been thawed out very quickly and economically by means of a chemical mixture. Caustic soda and aluminum chips, in the proportion of 25 per cent soda and 75 per cent aluminum by volume, were the ingredients. In the presence of a small amount of water a chemical action takes place which liberates quite a quantity of heat. From 2 to 4 lb. of the mixture is sufficient to thaw the ice in a frozen hydrant in less than five minutes. As used in Evanston, the hydrant cap is unscrewed and the material is poured in on top of the ice. Flushing the hydrant immediately after it is thawed avoids the danger of chemical corrosion of the metal. This method has been in use in Evanston for the past three years and is considered successful. The cost per hydrant has been between 60c. and $1.

Cost of Exchequer Dam

The Merced Irrigation District, of Merced, Calif., has submitted a formal statement to the Federal Power Commission showing the original cost of its Exchequer dam to have been $11,441,112.66 as of Dec. 31, 1927. Additions and betterments prior to Sept. 30, 1928, have cost $15,609.15. The license was issued to the irrigation district June 10, 1924, for its 33,000-hp. project. The dam is of the simple arch type, 330 ft. high, built on a radius of 675 ft.

Flat-Slab Concrete Track Deck in St. Louis Union Station

Subway for Baggage Trucks Carries Heavy Locomotive Loading—Design Details and Construction Methods

By W. F. Saunders, Jr.
Assistant Engineer, Dwight P. Robinson Company, St. Louis, Mo.

IN THE enlargement of the union station at St. Louis, Mo., as described in *Engineering News-Record* of Nov. 22, 1928, p. 766, a trucking subway with flat-slab roof carrying the station tracks and platforms is noteworthy not only for the many problems introduced by its irregularity of layout but also for the feature of a 30-ft. span with a 21-in. slab under a loading of E-60, plus 30 per cent impact. This slab carries the new station tracks across the baggage and express subway and the basements of two old express buildings, the upper stories of which were razed while the basements were retained in service. A view of the subway is given in Fig. 1, while Fig. 2 shows the deck slab under construction.

Design of Deck Slab—Comparison of preliminary designs for reinforced-concrete and steel decking showed concrete to have a decided advantage in cost as well as in lower maintenance, better appearance and greater headroom. This last was extremely important, as the subway and basements are traversed by loaded trucks and the floor elevation is fixed by several large sewers.

The plan (Fig. 3) shows the irregularities of column and panel arrangement forced by various conditions, including the obligatory north and south alignment of columns to permit trucking passageway, and the displacement of various columns to avoid sewers. A typical panel is illustrated in Fig. 4. An arrangement of approximately rectangular panels, parallel to the tracks and the old basement walls, was found to be ill adapted to railroad loading, as in some cases tracks would have fallen in the mid-strip of the panel, which is not the strip best fitted to carry the greater portion of the load and where the influence of unbalanced loading of tracks would have the greatest effect on the transverse strips. It was finally determined that the best design was that of twin columns centered under the tracks wherever possible, thus supporting the loads in the most direct manner and eliminating almost entirely the effect of unbalanced loading. This arrangement excluded the possibility of panel repetition, there being two panels which occur twice each and one which occurs four times. But the increased labor of design was justified by the results obtained.

Self-Supporting Platforms—This feature of the design contributed materially to the economy. As shown by the section in Fig. 3, pairs of tracks alternate with 14-ft. passenger platforms about 3 ft. high. Their concrete sidewalls were utilized as beams, and the platforms were designed to carry themselves and the canopy loads from column to column. It was found that under full loads the deflection of the subway roof slab was greater than that of the platform beams, thus insuring that the platforms would function as designed. A tar-paper joint was laid between the slab and platform beams, except at bearing points, and the beams were doweled into the subway roof slab at the bearings so that they might act as guard rails.

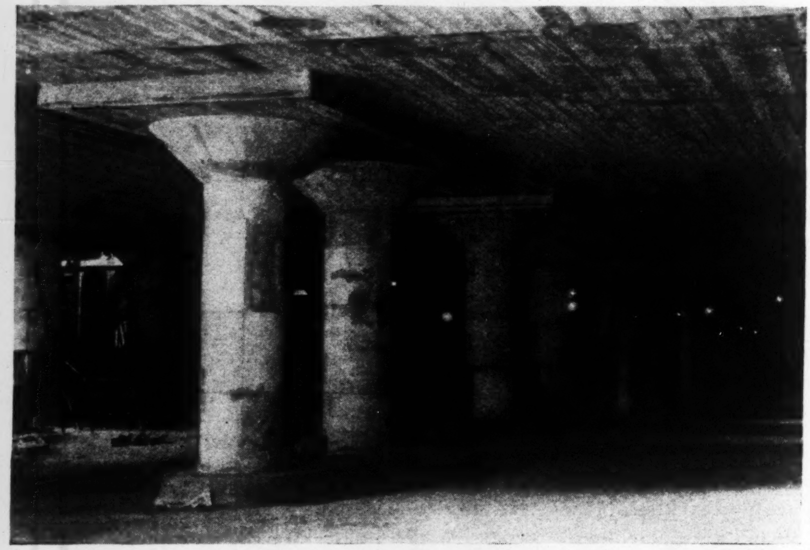


FIG. 1—FLAT-SLAB SUBWAY IN ST. LOUIS STATION
Note twin-column arrangement. Roof supports station tracks and platforms.

It was planned originally to pour these platforms on cinder fill, wasting the inside beam forms, but a more economical method, suggested by the contractor, was used. Openings 3 ft. wide and the full width of the platform were left in the platform slab between each two of the crossbeams which carry the canopy columns, the forms being salvaged through these holes and the gaps filled in on forms which were wasted.

Foundations and Bearing Walls—Borings showed a quicksand stratum overlain with hard clay, a 12-ft. thickness of which was adequate for 5,000 lb. per square foot, as proved by soil tests. This permitted in most cases the use of spread footings, constructed in pairs, but piles were used where the proximity of sewers necessitated deep footings. Although the basement walls of the old buildings had as a rule sufficient footing, it was not possible to use them invariably for bearings. It was often necessary to place columns fairly close to the walls in order to keep the spans within reasonable limits or to simplify other features of design. As the walls had

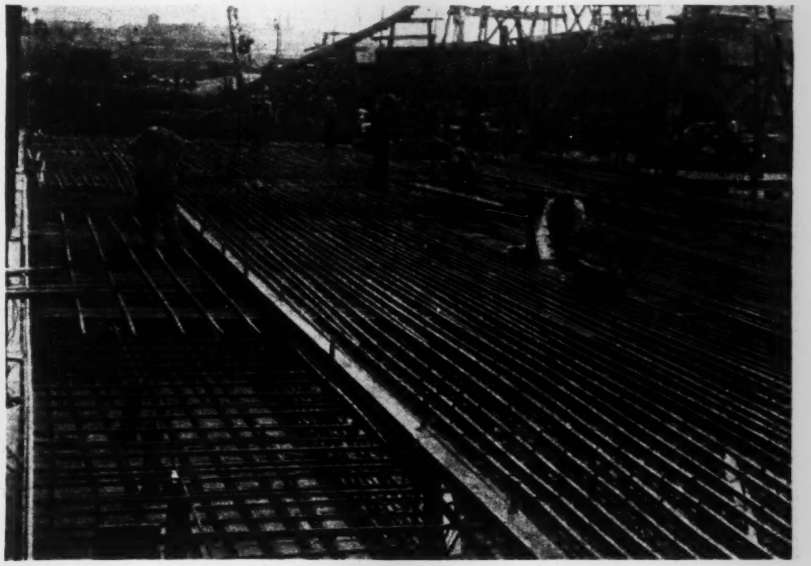


FIG. 2—HEAVY REINFORCING FOR TRACK SLAB

been under load for 25 years, it was judged that they had taken nearly all of their settlement, whereas soil tests showed a probable settlement of $\frac{1}{8}$ to $\frac{1}{4}$ in. in the new footings. The computation of settlement moments showed that spans of 15 ft. or more, depending upon conditions of continuity, were necessary to take up the expected settlement without producing excessive moments. Where this condition prohibited bearing on the old walls, recourse was had to cantilevers or to skipping the interior wall and taking the bearing on the outside wall.

In general, the old walls were blasted down to approximately the required height, trimmed with air chisels and built up with reinforced-concrete caps designed to give lateral as well as vertical strength. These caps were troweled smooth and painted with a thin layer of asphalt, to allow as much freedom of expansion as possible. At points where the slab was non-bearing, two thicknesses of compressible composition board were placed upon the cap and the concrete was deposited upon it. An expansion joint was provided at each of the natural bottlenecks of the slab. At one joint the slab rests in a recess in the column head; at the other it rests upon the wall cap. In both cases the lower surfaces are troweled smooth and painted with a thin layer of asphalt, while the vertical joint is made with $\frac{3}{4}$ in. of asphalt expansion joint material. Vertical $\frac{3}{4}$-in. asphalt-filled joints were also made along the interior wall for simplification of design.

Determination and Distribution of Moments—A two-way reinforcement being used, the longitudinal (parallel to tracks) and the transverse moments were separately determined. Conditions in a railroad deck are so dissimilar to those in ordinary flat slabs that it was not deemed advisable to take for granted the empirical rules of flat-slab design, but a meticulous check of the moments was made by the method of variable moments of inertia. For the interior spans this justified the use of the ordinary formula of center-to-center length minus two-thirds the diameter of the column head, but it showed that for the end spans something nearer to the center-to-center span should be used.

Some of the longitudinal moments were figured first by the use of the equivalent uniform loads given in the tables and were then checked by influence lines for the separate wheel loads. The difference in the results in general was not more than 5 per cent, but in some of the end spans of odd length the differences were so great as to indicate the advisability of using influence lines for all but typical cases. Full continuity was figured from one end of expansion joint to the next.

For typical cases the longitudinal positive moments for one track were considered to be resisted by a "track strip" (corresponding to the "column strip" in the ordinary flat slab) 12 ft. wide and centered on the track and a mid-strip 6 ft. wide, which is half of the width between two adjacent track strips (see Fig. 4). The live load was considered as applied over the full track strip

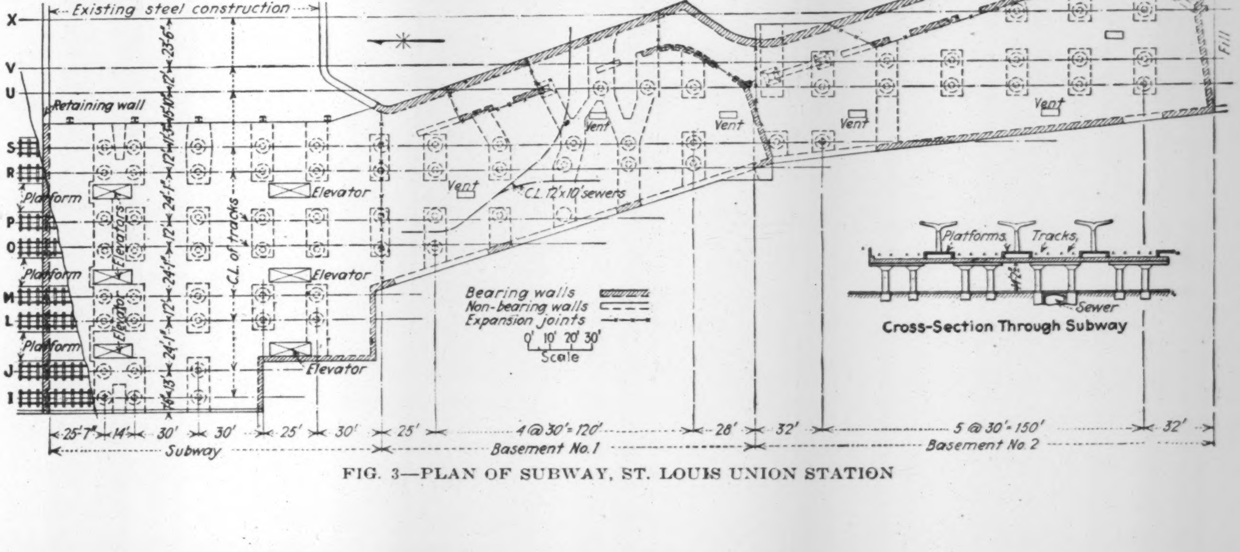

Existing steel
Possible future tracks
Existing steel construction
X
V
U
S
R
P
O
M
L
J
I
Retaining wall
Platform
Platform
Platform
Elevators
Elevator
Elevator
Elevator
Elevator
Elevator
23'-6"
12'
15'-10"
15'
12'
24'-1"
12'
24'-1"
12'
24'-1"
13'
7'-6"
C.L. of tracks
Vent
Vent
Vent
Vent
Vent
C.L. 12'x10' sewers
Fill
Bearing walls
Non-bearing walls
Expansion joints
0' 10' 20' 30'
Scale
Platforms
Tracks
Sewer
Cross-Section Through Subway
25'-7"
14'
30'
30'
25'
30'
25'
4 @ 30' = 120'
28'
32'
5 @ 30' = 150'
32'
Subway
Basement No. 1
Basement No. 2

FIG. 3—PLAN OF SUBWAY, ST. LOUIS UNION STATION

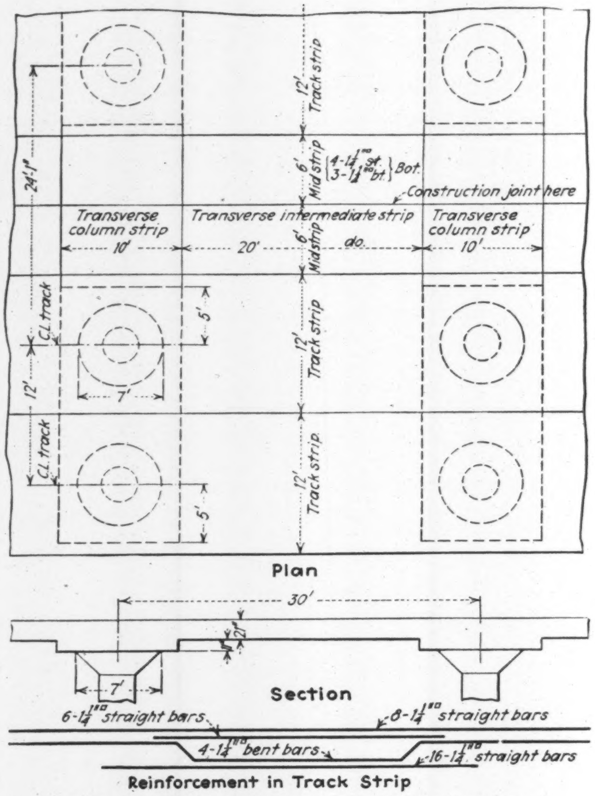


FIG. 4—TYPICAL PANEL OF SUBWAY ROOF

and as being transferred in part to the mid-strip, transverse reinforcement being provided as required. Computation of the relative deflections showed that the ratio of the loads carried by the two strips averaged about three-fourths carried by the track strip and one-fourth by the mid-strip. At the supports the mid-strip was reinforced to carry its share of the negative moment, but on account of the indeterminate nature of the conditions the track strip was reinforced to carry the full negative moment at the column head.

The negative moments were found to extend beyond the fifth point in most cases and occasionally throughout the span. Economy of design, therefore, seemed to be best satisfied by running the top steel through all spans. This steel could also resist compression under positive moment, thus effecting a further saving in slab depth. The typical reinforcement shown in Fig. 4 is 0.8 per cent, but in some cases it ran as high as 1.7 per cent. Compression steel is used also in most of the transverse bands in the same percentages and wherever occurring (bottom or top) it is anchored by ¼-in. round continuous sinusoidal stirrups 12 in. high.

The transverse column strips are continuous series of spans from one side of the structure to the other and were computed as such. The loading was assumed to be uniformly of one intensity over the track strip and of another intensity over the mid-strip, the intensities corresponding to the above ratio of the loads carried by the two strips. The platform beam reactions were taken as concentrations. In computing the longitudinal live and dead load reactions on the transverse column strips, the effect of continuity was considered. In certain cases, such as at end spans, this gave results more than 20 per cent greater than would have been obtained had continuity been neglected.

In order to obtain a greater effective depth in the longitudinal direction, the bottom longitudinal steel was figured below and top steel above the corresponding bars of the transverse bands. It would probably have facilitated placing if the longitudinal top bars had been below the transverse top bars, but the extra 1¼ in. of depth was more desirable than ease of placing.

Design of Columns—Bending in the columns was determined by computing the unbalanced dead load moment at the column (generally zero, except at end spans), plus the live load unbalanced moment for a certain position of the wheel loads, and proportioning this moment between the column and the next span of slab in ratio to the moment of inertia divided by length to the hinge point. Then the column was designed for this moment and the coincident direct load. Usually the worst case was given by only one span loaded with the four engine wheels so placed as to produce the maximum negative moment at the column. While the negative moments in the transverse column strips were high, the use of the twin columns generally reduced the transverse moments in the columns to a negligible quantity.

To lessen crowding of the steel, the column bars were stopped just short of the bottom longitudinal reinforcement, a check of the bending at the plane of the bottom of the slab showing that at that section no tension could exist. These columns varied from 36 to 42 in. in diameter and in two instances had double-concentric cores.

Construction Methods—The concrete was chuted from a 1-yd. mixing plant located about midway of the job. The specifications required the concrete to be as dry as chuting would permit and to be mixed for a full minute, which gave results on test cylinders consistently above the 2,000 lb. required. Construction joints were run down the middle of the mid-strip area (see Fig. 4), transverse stops being used as rarely as possible and always rabbeted and roughened. This resulted in long pours (the greatest being 480 cu.yd.), which the contractor was able to handle with one shift by working long hours. A record for St. Louis work was made on one pour of 470 cu.yd. begun at 5 a.m. and completed at 5:30 p.m.

The lower layer of reinforcement was carried on ½-in. round bars supported by frequent sheet-iron V's lying on their sides, giving 1½-in. covering beneath the reinforcement. The upper layer was carried on 4x4-in. concrete blocks spaced about 4 ft. apart. This method of support proved successful where the usual methods had been inadequate to support the extraordinary load of 10 tons of steel per panel. The forms were built in the manner customary for buildings, except that many more shores were used.

Rerolled rail-steel bars were used for the reinforcement. The stresses used were 16,000 lb. on steel and 650 lb. on concrete in bending. For other stresses and details of design the specifications of the American Concrete Institute for 2,000-lb. concrete were followed.

Personnel—The complete expansion program for the station, including the subway, was carried out by the Dwight P. Robinson Company, Philadelphia, Pa., under the supervision of C. E. Haywood, chief engineer, and S. C. Willis, superintendent of construction. The design of the slab deck was executed for this company by the writer, with the aid of L. N. Beals. The contractor for the slab was the McCormack-Combs Construction Company, St. Louis, Mo. Both design and construction were under the direction of H. J. Pfeifer, chief engineer of the Terminal Railroad Association of St. Louis.

Uniform Aggregate Specifications in Use in Detroit

History of Detroit Engineering Society's Efforts to Eliminate Chaotic Conditions in Concrete Materials Field

By L. G. Lenhardt
Department of Water Supply, Detroit, Mich.

BEGINNING at the time that concrete was first used in Detroit, the conditions under which aggregates were supplied were never satisfactory. Practically every architect and engineer had his own specifications, as did the various departments of the city government. The aggregate producers were not long in recognizing this chaotic condition. The enormous volume of construction which has been under way in this city during the last twenty years has been supplied with aggregate purchased, until quite recently, on a sellers' market. Despite multiplicity of specifications, the best any user could do was to recognize this fact and permit a minimum of deviation from what was wanted.

These conditions existed until late in 1924, when the Detroit Engineering Society determined to try to write a specification which would have the approval of both users and producers. A committee representing material men, contractors, architects and engineers was appointed and labored for one year, producing a specification which represented a considerable step in advance.

This specification never had a wide acceptance, partly because those specifying concrete were loath to give up their pet ideas. Briefly, however, the failure of this specification to enlist a larger following was due to a lack of educational work.

About this time there came a gradual awakening to the value of concrete control methods, largely as a result of the efforts of the Detroit Engineering Society in fostering concrete control schools put on by the Portland Cement Association. The department of buildings of the city embarked on a comprehensive campaign for better concrete, and certain organizations such as the Detroit Edison Company, Smith, Hinchman & Grylls, architects, and the Detroit Water Board adopted concrete control methods, with the result that more rigid aggregate specifications began to be written; but again, every organization was working along its own lines. The result was that the multiplicity of specifications became even more pronounced than it was before.

During this time the concrete committee of the Detroit Engineering Society was kept alive and about a year and a half ago started revision of the first specification. This revision was finally approved as given herewith and has been widely adopted. Among those using the new specifications are the following: Detroit Edison Co.; Detroit Water Board; Detroit Department of Public Works; Smith, Hinchman & Grylls, architects and engineers; Malcomson & Higginbotham, architects, and the Ford Motor Co. on its new water intake and tunnel system.

Aggregate Specifications—Detroit Engineering Society

Coarse Aggregate

General Characteristics

1. Coarse aggregate shall consist of hard, strong, durable pebbles, crushed stone or slag, free from adherent coatings and clay lumps. (If limitation to one or more of above-mentioned aggregates is desired, it shall be definitely specified.)

2. The maximum percentage of deleterious substances shall not exceed the following values:

	Per Cent by Weight
Removable by decantation	1
Shale and soft fragments	3
Coal	½
Thin, elongated or laminated pieces	3

3. Coarse aggregate shall pass a sodium sulphate accelerated soundness test except that aggregate failing to pass such test may be used if it passes a satisfactory freezing and thawing test.

4. Crushed stone for one-course pavement shall show a loss by abrasion not exceeding 3 per cent; for pavement base 6 per cent.

5. Crushed slag shall weigh not less than 1,900 lb. per cubic yard. It shall contain not over 2 per cent of sulphur and it shall be weathered for not less than three months.

6. Wherever in these specifications methods of test or standards are referred to or implied, the latest A.S.T.M. Standard dealing with such subject shall be used.

Gradings

7. Coarse Grading:

(*a*) Aggregate when tested by means of standard laboratory sieves shall conform to the following requirements:

Minimum fineness modulus, 7.00; maximum fineness modulus, 7.80.

	Per Cent
Retained on sieve, 2-in. square openings	0 to 2
Retained on sieve, 1½-in. square openings	5 to 20
Retained on sieve, ¾-in. square openings	40 to 75
Retained on No. 4 sieve	95 to 100

(*b*) Crushed stone or slag, used for pavement, when tested by means of standard laboratory sieves shall conform to the following requirements:

Minimum fineness modulus, 7.40; maximum fineness modulus, 8.05.

	Per Cent
Retained on sieve, 2-in. square openings	0 to 5
Retained on sieve, 1½-in. square openings	10 to 30
Retained on sieve, ¾-in. square openings	50 to 75
Retained on sieve, ⅜-in. square openings	85 to 100
Retained on No. 4 sieve	95 to 100

8. Medium Grading:

Aggregate when tested by means of standard laboratory sieves shall conform to the following requirements:

Minimum fineness modulus, 6.50; maximum fineness modulus, 7.00.

	Per Cent
Retained on sieve, 1½-in. square openings	0
Retained on sieve 1-in. square openings	0 to 5
Retained on sieve, ¾-in. square openings	10 to 25
Retained on sieve, ⅜-in. square openings	50 to 75
Retained on No. 4 sieve	90 to 100

9. Fine Grading:

Agregate when tested by means of standard laboratory sieves shall conform to the following requirements:

Minimum fineness modulus, 6.00; maximum fineness modulus, 6.50.

	Per Cent
Retained on sieve ¾-in. square openings	0
Retained on sieve ⅜-in. square openings	20 to 60
Retained on No. 4 sieve	85 to 100
Retained on No. 8 sieve	95 to 100

Fine Aggregate

General Characteristics

10. Fine aggregate shall consist of sand having hard, strong, durable particles free from adherent coatings, clay lumps and other deleterious substances.

11. (*a*) The amount removable by decantation shall not exceed 2 per cent by weight. (*b*) All fine aggregate shall be free from injurious amounts of organic impurities. Aggregates subjected to the colorimetric test for organic impurities and producing a color darker than the standard shall be rejected unless they pass the mortar strength test as specified in section 12.

12. Fine aggregate when subjected to the mortar strength test shall have a compressive and tensile strength at the age of seven and 28 days of not less than 100 per cent of that developed by mortar of the same proportion and consistency, made with the same cement and standard Ottawa sand.

13. Wherever in these specifications methods of test or stand-

ards are referred to or implied, the latest A.S.T.M. Standard dealing with such subject shall be used.

Gradings

14. Sand No. 1—Structural:

(*a*) Fine aggregate when tested by means of standard laboratory sieves shall conform to the following requirements:

Minimum fineness modulus, 2.70; maximum fineness modulus, 3.30.

	Per Cent
Retained on ⅜-in. sieve	0
Retained on No. 4 sieve	0 to 5
Retained on No. 48 sieve	80 to 95
Retained on No. 100 sieve	95 to 100

(*b*) At least 15 per cent of the sand shall be retained between each of the following pairs of sieves: Nos. 8 and 14, 14 and 28, 28 and 48.

15. Sand No. 2—Pavement, Mass Concrete, etc.:

(*a*) Fine aggregate when tested by means of standard laboratory sieves shall conform to the following requirements:

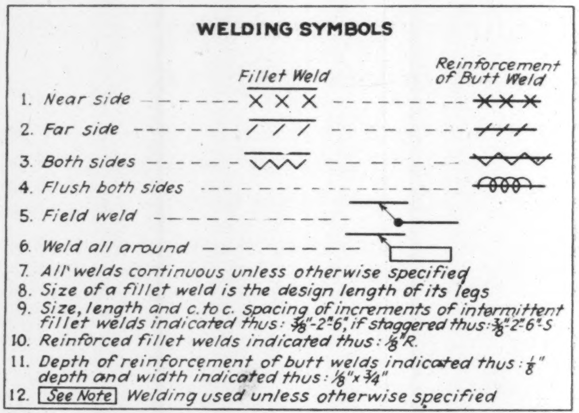
Minimum fineness modulus, 2.60; maximum fineness modulus, 3.60.

	Per Cent
Retained on ⅜-in. sieve	0
Retained on No. 4 sieve	0 to 10
Retained on No. 48 sieve	80 to 95
Retained on No. 100 sieve	95 to 100

(*b*) At least 10 per cent of the sand shall be retained between each of the following pairs of sieves: Nos. 8 and 14, 14 and 28, 28 and 48.

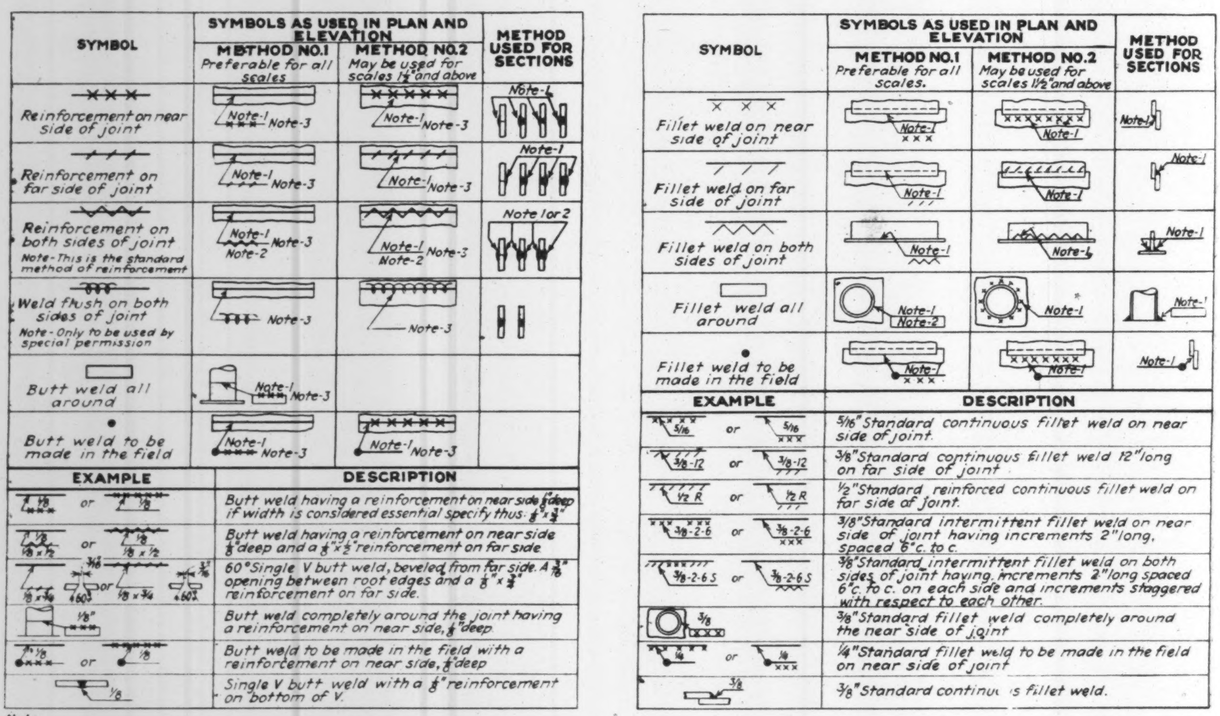
Welding Symbols for the Draftsman

A bulletin recently published by the American Welding Society, containing the report of the society's committee on nomenclature, definitions and symbols, includes several charts that should prove useful to draftsmen confronted with the task of showing welded details on their drawings. These charts are reproduced here as useful additions to the literature on structural welding. The bulletin itself is available from the American Welding Society for a nominal charge of 50c. The text, exclusive of the index, consists of 43 pages divided into four sections. In section 1, on nomenclature, the names of the principal welding processes are given in full and there is a diagram which illustrates their interrelation. Definitions are given in section 2 and abbreviations in section 3. The symbols occupy section 4, and are for use in connection with both the resistance and fusion welding processes. In this article only those relating to fusion welding are given, since these are the only ones which apply directly to structural work.


WELDING SYMBOLS
Fillet Weld
Reinforcement of Butt Weld
1. Near side
2. Far side
3. Both sides
4. Flush both sides
5. Field weld
6. Weld all around
7. All welds continuous unless otherwise specified
8. Size of a fillet weld is the design length of its legs
9. Size, length and c. to c. spacing of increments of intermittent fillet welds indicated thus: ⅜"-2"-6", if staggered thus: ⅜"-2"-6"-S
10. Reinforced fillet welds indicated thus: ⅜R.
11. Depth of reinforcement of butt welds indicated thus: ⅛" depth and width indicated thus: ⅛"×¾"
12. See Note Welding used unless otherwise specified

Note:
Specify on stamp the welding process most extensively used, viz: metal arc, gas etc.

FIG. 2—SUGGESTED FORM OF STAMP TO BE USED ON DRAWINGS, SHOWING WELDED DETAILS


SYMBOL
SYMBOLS AS USED IN PLAN AND ELEVATION
METHOD NO.1 Preferable for all scales
METHOD NO.2 May be used for scales 1½" and above
METHOD USED FOR SECTIONS
Reinforcement on near side of joint
Reinforcement on far side of joint
Reinforcement on both sides of joint
Note - This is the standard method of reinforcement
Weld flush on both sides of joint
Note - Only to be used by special permission
Butt weld all around
Butt weld to be made in the field
Note-1
Note-2
Note-3
Note 1 or 2
EXAMPLE
DESCRIPTION
Butt weld having a reinforcement on near side ⅛" deep if width is considered essential specify thus: ⅛"×¾"
Butt weld having a reinforcement on near side ⅛" deep and a ⅛"×½" reinforcement on far side
60° Single V butt weld, beveled from far side. A ⅛" opening between root edges and a ⅛"×¾" reinforcement on far side.
Butt weld completely around the joint having a reinforcement on near side, ⅛" deep.
Butt weld to be made in the field with a reinforcement on near side, ⅛" deep
Single V butt weld with a ⅛" reinforcement on bottom of V.
SYMBOL
SYMBOLS AS USED IN PLAN AND ELEVATION
METHOD NO.1 Preferable for all scales.
METHOD NO.2 May be used for scales 1½" and above
METHOD USED FOR SECTIONS
Fillet weld on near side of joint
Fillet weld on far side of joint
Fillet weld on both sides of joint
Fillet weld all around
Fillet weld to be made in the field
Note-1
Note-2
EXAMPLE
DESCRIPTION
5/16" Standard continuous fillet weld on near side of joint.
⅜" Standard continuous fillet weld 12" long on far side of joint
½" Standard reinforced continuous fillet weld on far side of joint.
⅜" Standard intermittent fillet weld on near side of joint having increments 2" long, spaced 6" c. to c.
⅜" Standard intermittent fillet weld on both sides of joint having increments 2" long spaced 6" c. to c. on each side and increments staggered with respect to each other.
⅜" Standard fillet weld completely around the near side of joint
¼" Standard fillet weld to be made in the field on near side of joint
⅜" Standard continuous fillet weld.
or

Note:-
1. Give size of reinforcement here in terms of depth, or depth and width
2. Give size of reinforcement on far side here, if different from size of reinforcement on near side.
3. Make free-hand sketch of joint here if shape of joint edges, spacing of root edges and side from which beveled is not obvious. The upper side of the sketch will be understood as the near side.

BUTT WELDS

Note:-
1. Give size and continuity of weld here. See examples.
2. Show symbol for location here. See example

FILLET WELDS

FIG. 1—CONVENTIONAL WELDING SYMBOLS

Rapid Driving of 2,600 Wood Piles on a Chicago Building

Timber and Steel Piledriver Rigs With Steam Hammers—Frozen Ground Broken by Skull-Crackers

By J. D. Levin
Engineer, Wells Brothers Construction Co., Chicago

IN 35½ working days 2,649 wood piles, aggregating 145,000 lin.ft., were driven for the new building of Montgomery Ward & Co. at Chicago Ave. and the Chicago River during February and March, 1929, using two piledrivers. The plans called for 2,475 wood piles with a minimum spacing of 30 in. c. to c., the footings being designed for 50,000 lb. per pile, the maximum allowed by the Chicago building code. To meet this requirement, each pile had to withstand at least 24 blows during the last foot of driving or to show an average penetration not greater than 0.5 in. per blow during the last foot of driving. To compensate for low driving values in certain parts of the lot, it was necessary to drive 174 extra piles to attain the required bearing. Except along the river dock, where timbers, old piles, boulders and earth pockets were encountered, 2,570 piles 55 ft. long were driven in typical Chicago clay. To insure better bearing along the riverbank, 80 piles 60 ft. long were driven.

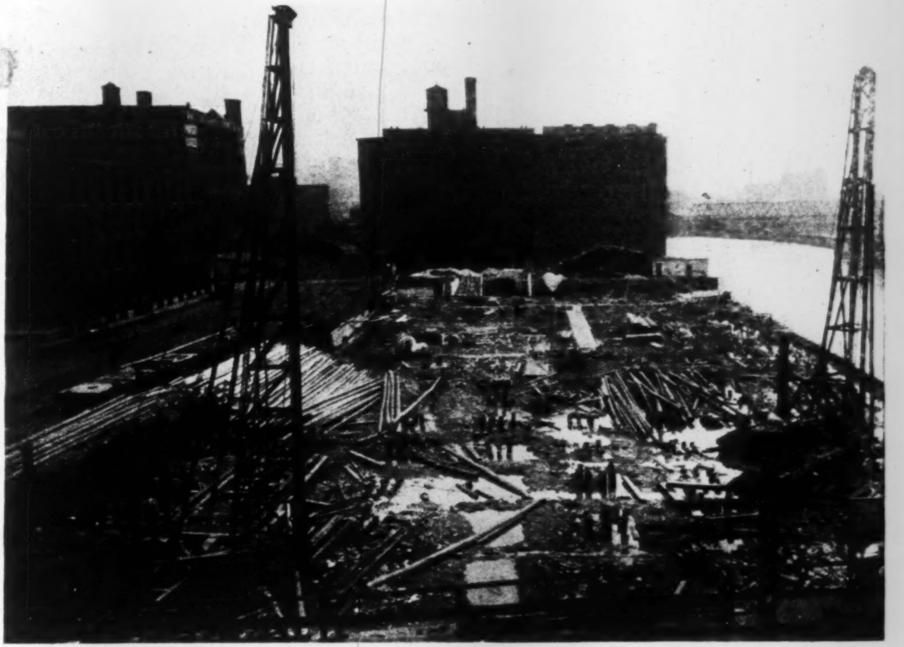
Steam-shovel excavation was carried deep enough to allow for 1 ft. of pile swell. Three 1-yd. shovels handled 20,000 cu.yd. of clay, cinders and old masonry foundations in three weeks. Cast-iron skull-crackers weighing 3,500 lb. were employed to loosen the ground, which was frozen to a depth of 3 ft. All piles were cut off 1 ft. below city datum. Piledriving and cutting-off operations along the riverbank were hindered by the unusually high water.

A Welded Piledriving Rig

Two piledrivers with 75-ft. leads and single-acting steam hammers were employed; driving radius, 20 ft.; total weight of hammer, 10,000 lb.; weight of driving ram, 5,000 lb.; effective distance, 3 ft. One driver had the usual timber rig, but with steel channel guides instead of the usual 16x16-in. timbers. The other had an all-steel welded rig, of 8- to 16-in. H-sections with bracing of 4x4x⅜-in. angles. Each driver had a 14-ft. turntable, and the steel driver had a separate swinging engine, which facilitated its operation. The total weight of the all-steel driver, designed by O. E. Strehlow, consulting engineer, was about 16 per cent less, giving better control and fuel economy. The first cost is about the same, but erection and dismantling costs are said to be about half those of a timber piledriver; and while the latter is usually replaced entirely in six or eight years, the steel rig is considered practically indestructible.

A typical piledriver crew consisted of nine men: foreman, hoisting engineman, fireman, winch hand, guide man high up on rig, guide man at base of leads, two men handling piles on ground and one man squaring heads of piles to fit hammer plate. Loads of 50 piles each were lashed on two flat cars coupled together and delivered on a spur track adjacent to the site, where two men with cant-hooks rolled the logs onto the storage piles.

Under the supervision of the writer, who served as field engineer for the general contractor, a man was detailed to keep in a bound notebook a record of each pile driven on the job. Each footing was designated by the intersecting center lines and each pile in each footing was given a specific number. Date of driving, length of pile, length of cutoff and number of blows during the last foot of driving were recorded for each pile. The *Engineering-News* formula for single-acting steam hammers was used in the determination of the required penetration for a maximum allowable load of 50,000 lb. per pile.



PILEDRIVING FOR CHICAGO BUILDING
Driver at left is of welded steel construction with H-beams and angle bracing. Driver at right is of timber, but with H-beam leads. Piles are being rolled off cars to stockpile.

Out of a total of 568 driver-hours, 40 hours, or 7 per cent, were spent in moving runs and timbers for driving; seventeen hours, or 3 per cent, in moving pile butts and débris; and six hours, or 1 per cent, through breakdowns and other unavoidable delays due to winter conditions. The Wells Brothers Construction Co. was the general contractor, with E. J. Wheeler as general superintendent and the writer as field engineer. Walsh & Masterson were subcontractors for piledriving. W. H. McCaully was chief engineer in charge of construction and design for the owner of the building, Montgomery Ward & Co.

Channel Tunnel Gets Indorsement

Majority of Committee Appointed to Consider Practicability of 36-Mile Link Under Water Between England and France Gives Cautious and Qualified Approval—Cost and Engineering Conditions Outlined

IF GEOLOGICAL conditions prove favorable, and provided the project is carried out by private enterprise alone, and although some interest may be adversely affected, "the construction of a Channel tunnel, by creating new traffic and thus increasing trade, would be of economic advantage" to England. This cautious and qualified statement is the conclusion of the majority of a committee appointed by the British government a year ago to consider the economic aspects of a tunnel connecting the railways of England and France. But on the same evidence the fifth member of the committee arrives at diametrically opposite opinions and is "opposed to the scheme on economic grounds."

Thus the 60-year-old project does not seem to get much support from this latest of many investigations. As to economic aspects of the tunnel, the report deals with two subjects: engineering (that is, construction and operation) and traffic. Its military aspects are left for consideration by a government committee on national defense, and for 50 years equivalent committees have strongly opposed and successfully defeated projects for such a physical international connection.

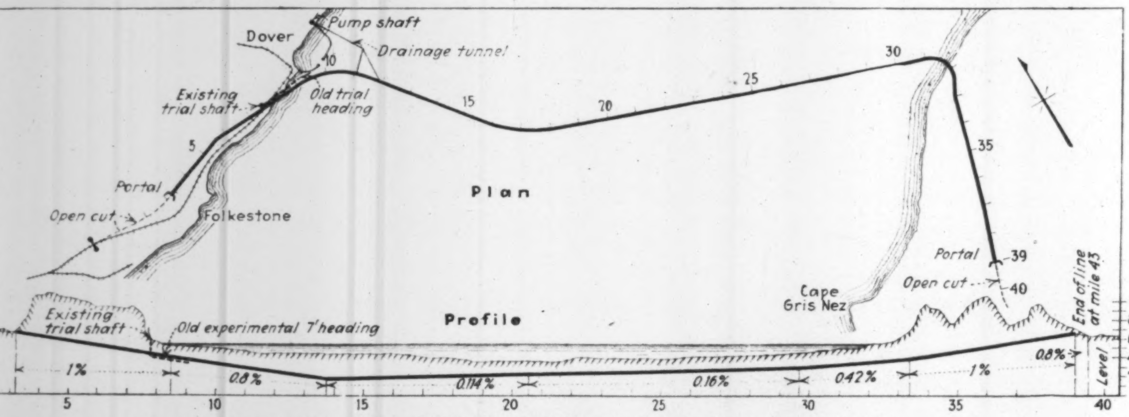


FIG. 1—CHANNEL TUNNEL BETWEEN ENGLAND AND FRANCE

A 36-Mile Tunnel Project

The present revival of the project calls for a tunnel under the narrow Straits of Dover to provide a continuous railway route between London and Paris, superseding the shortest of the present steamship routes. It is promoted by the Channel Tunnel Co. and is backed to a limited extent by the Southern Railway, in England, and the Northern Railway, in France, both lines agreeing to make the necessary connections and operating agreements if the tunnel company carries out its work. The tunnel, located as shown in Fig. 2, would be 36 miles long between portals, with 24 miles under the sea and 6 miles on each side, followed by about 5 miles of open cut. The depth of water is 120 to 200 ft. and the tunnel would be 120 to 250 ft. below the bottom of the sea. Electric traction and automatic signals are assumed for the operation.

In its tentative location the tunnel is not straight throughout. As shown in Fig. 1, its submarine portion is on a long swing or curve southward to keep within the supposed limit of solid rock, while the approaches are parallel with the coast lines, that on the French side being practically at right angles with the Channel portion. It is laid out with grades of 0.8 to 1 per cent for the approaches and 0.4 to 0.11 per cent for the Channel portion.

Channel Steamer Lines—Of the present steamship routes, shown in Fig. 2, the shortest are about 21 miles and are practically paralleled by the tunnel line. Although rough weather prevails at times, it has been stated that interruption to the service does not exceed about five days in the year. In addition, there are numerous longer routes, there being in all about a score of steamship routes from half a dozen British ports to points in France, Belgium and Holland. All of these are well equipped with modern vessels, docks and terminal facilities. For the tunnel, it is claimed that the sea passage deters many would-be travelers, though on the other hand it is a direct attraction to many travelers; in fact, the committee points out, the fear of a journey through a 36-mile tunnel under the sea might be as deterrent as the fear of a sea passage.

It is partly on the basis of the present numerous steamer routes that the committee definitely opposes any financial assistance of the tunnel project by the government. It points out that railways which have made large investments in developing these services might have reasonable basis to claim compensation for damages should the government assist a competitive project that would take away much of their business.

No Difficult Technical Problems

Engineering Conditions—As an engineering problem the tunnel appears to present no serious difficulties. Geological studies indicate a deep and continuous bed of the solid chalk rock which forms the cliffs on each side of the channel; this rock is readily excavated. However, the value of such studies must be regarded with reserve in view of tunneling experiences in the United States, Japan and Europe. Short trial headings were driven many years ago and later experiments with tunneling or rock-boring machines proved satisfactory.

For the technical aspects of the problem, the committee wisely secured competent engineering assistance. Three leading firms of consulting engineers, acting in unison, report that the feasibility of construction must depend upon the nature of the ground and that, while geological studies indicate a continuous rock stratum, neither these nor borings can insure against the existence of fissures or faults. Large fissures filled with coarse gravel and in communication with the sea "would be very serious." Compressed-air working could not be employed in such a case, owing to the great pressure, say 150 lb., equivalent to the head of water above the tunnel. It has been proposed to churn the excavated rock with water so that it could be handled by pumping, but the estimates provide for removing the spoil by cars.

As proposed by these engineers, somewhat modifying the company's plans, a 12-ft. pilot tunnel and a 7-ft. drainage tunnel (see Fig. 3) should be driven for the entire distance under the Channel before starting the main tunnels. The pilot tunnel would be kept in advance and bore holes would be driven from it to explore the ground ahead and around it. This tunnel would serve for the construction railway and other facilities for the two 18½-ft. main tunnels, lateral drifts providing for numerous headings on the latter. Finally, it would serve as a ventilating accessory. The drainage tunnel would provide gravity flow from the center of the tunnel to a pump shaft on each shore and would take care of water encountered by the main headings. The main tunnels would be lined throughout.

Cost Would Exceed $150,000,000

With the use of rotary excavators, or tunneling machines, it is estimated that these two preliminary tunnels could be driven in five years. After their completion the two railway tunnels could be completed and equipped in three years. The estimated cost is $28,000,000 for the two smaller tunnels and $126,500,000 for the larger tunnels, or a total of $154,500,000 for the complete project, including the open-cut approaches, electrical equipment and signaling, but exclusive of land, stations, electric generating plants and electric locomotives. Train movements would probably create sufficient ventilation, which could be regulated by means of the pilot tunnel and supplemented, if necessary, by fans.

Traffic—Passenger traffic is the primary consideration in this project. In fact, the committee says: "The chief merit claimed for a tunnel lies in the anticipated increase of cross-Channel passenger traffic." On the basis of a total of 2,266,000 passengers by all the steamer routes in 1928, calculating the annual increase, estimating the amounts that may be diverted from present sea routes and also estimating new traffic to be developed by the tunnel, varying estimates of the number of passengers for the first year of tunnel operation (about 1940) have been prepared, as follows: Channel Tunnel Co., 3,577,500 (or 4,000,000 in published statements); Southern Railway, England, 1,525,000; Northern Railway, France, 3,200,000; tunnel committee, 2,357,000.

Freight Traffic Negligible Factor

While there is considerable freight traffic between England and the Continent, the tunnel would handle principally such perishable freight as fruit, vegetables and dairy products imported by England. For this reason, English growers and producers are opposed to the tunnel on the grounds of increased competition. However, the committee considers that freight traffic would be of very secondary importance as far as the tunnel is concerned.

While the difference of about $\frac{3}{16}$ in. in the track gage of the English and continental railways may be neglected, except as somewhat affecting wear of rails and equipment, there is an important difference in the loading gage or clearance limits. Thus the permissible height and width of cars are materially greater on the continental lines of approximately standard gage. In earlier stages of the tunnel project, this feature was held to necessitate costly changes on the English line between London and the tunnel so as to admit the passage of the larger foreign rolling stock. It appears from the present report, however, that the foreign lines would consent to the use of equipment conforming to the smaller English loading gage, as is the case with cars for international freight traffic handled by the car-ferry steamers.

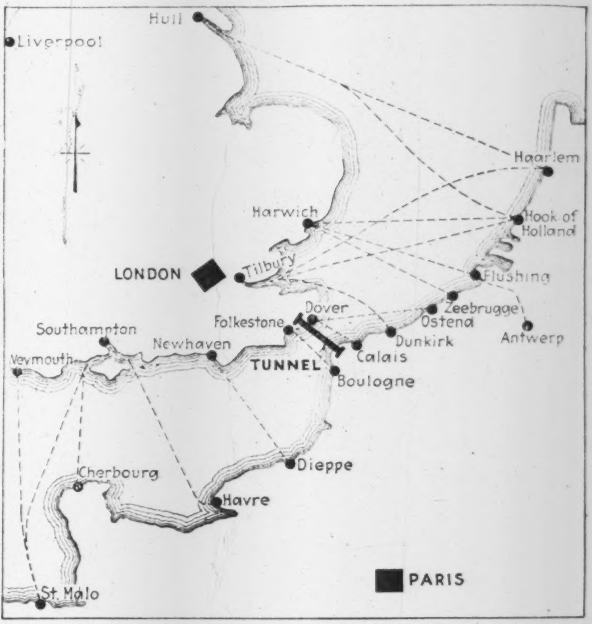


FIG. 2—CHANNEL TUNNEL AND STEAMER ROUTES

Employment of Labor—With the serious unemployment situation in England, the labor aspect of this engineering project is touched upon in the report. The committee's engineers estimate that on each side of the Channel about 250 men would be employed directly and 750 indirectly during the five-year period of work on the pilot and drainage tunnels. During the subsequent three years required for the railroad tunnels these figures would be 1,550 and 4,500. But the committee points out that with the opening of the tunnel there would be a large reduction in the present number of employees engaged on the railways, docks and vessels in connection with the Channel traffic.

Channel Crossing by Air and Water

Airships and Car Ferries—Although cross-Channel travel by air increased from 20,721 passengers in 1925 to 43,179 in 1928 and is certain to increase further, the committee considers that its total will be only a very small proportion of the traffic. Apparently it gave little consideration to the rapid development of air transport, but devoted much study to the past and prospective growth of ferry service.

As to car ferries, only passenger traffic is considered and the conclusion is that ferry service would be unsuitable for the short-route crossings, since the available ports would make it nceessary to use relatively small boats of not more than 14 ft. draft. Therefore trains would have to be split, causing loss of time, and in rough weather the ferry steamers would have little advantage over the fine passenger steamers now in use. Port improvements to allow for larger vessels of 18 ft. draft and to provide for the 21-ft. tidal range would be very costly, says the report. It appears, however, that the cost would be small as compared with that of the tunnel, while the building of port facilities and steamers would require much less time than building the tunnel. The committee also states that in any case a passenger car-ferry service "would offer few attractions as compared with the existing boat service," but omits to point out that the former would have the advantage of eliminating the inconvenience of passengers transferring twice between train and steamer. At present car ferries are used for freight traffic on some of the longer sea routes.

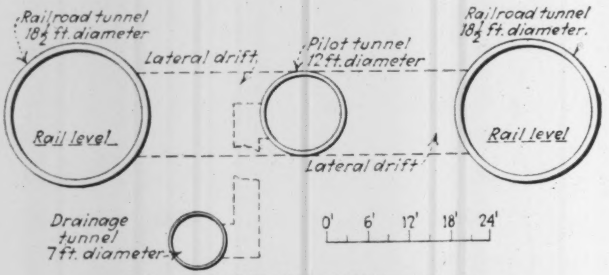

Railroad tunnel 18½ ft. diameter
Lateral drift
Pilot tunnel 12 ft. diameter
Railroad tunnel 18½ ft. diameter.
Rail level
Rail level
Lateral drift
Drainage tunnel 7 ft. diameter
0' 6' 12' 18' 24'

FIG. 3—PROPOSED TUNNEL PLAN
The pilot tunnel and drainage tunnel would be completed before beginning work on the two main tunnels.

Other Cross-Channel Projects—Brief mention is made of some other projects for eliminating the sea passage, most of them being antiques furbished up and presented before the committee. There is a rival tunnel scheme including a brand new double-track railway of 7-ft. gage all the way from London to Paris. This is classed as impracticable and its $1,000,000,000 estimated cost as prohibitive. The same conclusions are applied to the 22-mile railway bridge, $375,000,000, with main spans of 2,000 ft. (suspension type) and carried by 53 piers in a busy seaway subject to storms and dense fogs. A combined railway and highway tunnel is ruled out on account of danger from exhaust gases of motor vehicles in a 36-mile tunnel. Tube tunnels to be laid on the bed of the Channel or suspended in the water are disposed of as impracticable, as is the fantastic scheme for a solid embankment.

Military Aspects—While the present report does not deal with the problem of military use of the tunnel, which is left to a committee on defense, it may be explained that this rock has blocked innumerable Channel tunnel projects. Destruction of England's insular position and the possibility of invasion by some continental power have always loomed large in political, military and popular discussions of a Channel tunnel. A vast amount of skill and unrestrained ingenuity has been expended on protective methods, including the flooding of the tunnel and the blowing up of the portal or approaches. Against these it is urged that such protection would be a constant menace through accidental or malicious tampering. Nobody seems to have considered how an invading force could get rid of its first empty trains and how many trains could be got through before they blocked all further traffic. However, the military objection is probably the most severe and serious opposition that tunnel promoters have to face.

Sixty Years of Past History

History—Finally, brief mention may be made of the past record of the Channel tunnel project. Historically it dates back to 1800 as a paper proposition, but it began as a real issue in 1867, when an international commission was appointed at the suggestion of the Emperor Napoleon. The Franco-Prussian War delayed progress, but in 1875 both the British and the French governments granted concessions to companies proposing to build the respective portions of the tunnel. Each company put down a trial shaft and drove a short experimental heading. But in 1880 the British authorities raised strong military opposition, and until 1928 these sufficed to defeat the repeated attempts to revive the project. As a result of new efforts, however, the present committee was appointed in April, 1929, to examine and report on the economic aspects. Its report gives the project but lukewarm and half-hearted encouragement and indicates adverse public opinion, while the opposition based on military considerations still has to be met.

Primary Filters Increase Capacity of English Water Plant

Some important extensions at the Kempton Park pumping station of the Metropolitan Water Board were formally put into service on Oct. 24. These extensions, as described in *The Engineer,* (London), embody the installation of additional pumping engines and the construction of primary filters which will very materially increase the capacity of this unit of the water supply of the city of London.

The original works at Kempton Park comprised: (1) two storage reservoirs containing 360,000,000 gal.; (2) twelve slow sand filters, each with an area of ¾ acre; and (3) a pumping station containing five units, each consisting of a triple-expansion vertical engine driving a single-acting plunger pump. By installing primary filters the load on the slow sand filters has been so materially reduced as to make possible their operation at a very much increased rate of filtration.

Twenty-four rapid filters divided into four sets of six each have been installed at Kempton Park. Each filter is 26x16 ft. in plan and 11 ft. 9 in. deep. The filtering material consists of stones at the bottom with coarse sand at the top, the total depth being some 4 ft. Each filter is capable of dealing with from 1,200,000 to 2,400,000 gal. daily, at a rate of between 120 and 240 gal. per square foot per hour. Both air and water wash are used for cleaning the filters. No power-driven compressor is needed for the air wash, but instead, a compressing tank, from which the air is forced by means of the wash water pressure, is used to deliver air to the strainer system at the bottom of the filters. Sedimentation tanks are provided beneath each set of filters, into which the dirty wash water discharges, and the clarified water from the tank is then allowed to flow into a near-by stream. The sludge from this tank is removed to drying beds, and it is expected that the farmers in the neighborhood will remove this when dry and use it as a fertilizer. In addition to the above-mentioned extensions provision has been made for chlorinating the effluent.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Italian Work on Reinforced Concrete

REVIEWED BY A. C. JANNI
Consulting Engineer, New York City

PRONTUARIO PEL CALCOLO E L'ESECUZIONE DEL CEMENTO ARMATO: Nelle Costruzione Civili Per Ingegneri, Progettisti, Construttori, ecc.—By Ing. Luigi Narducci. 2d Edition, revised and enlarged. Torino: S. Lattes & C. Paper; 4¾x7½ in.; pp. 310; tables and 109 line cuts. 25 lire.

INTENDED primarily to be a handbook for reinforced-concrete designers in Italy, this book opens with a report of the Italian royal decree of June 7, 1928, concerning work in reinforced concrete by which all reinforced-concrete constructions are put under the direct supervision of the government; as well as characteristics of ingredients, quality of cement products at mills, laboratory tests, field tests of the completed works, etc. The engineer is required, in each case, to submit plans and complete calculations for the structure.

The book proper is in five parts: (1) aggregates, amount of water, reinforcing steel centering, etc.; (2) generalities on the analysis of structures; (3) analysis of concrete structures; (4) practical solutions of a few examples of concrete structures; (5) analytical formulas, as well as several graphical constructions, useful to a designer, in the solution of his problems.

The author seems to have been more concerned in putting into his work all the scientific material he could lay hold of than in presenting his subject clearly, by a logical development of the questions he was treating. For instance, Part II deals with the theory of structures in general. The subject is vast enough; yet he develops it in 54 small pages of rather large type. He cannot but be obscure to the reader who looks for help—for whom this book is supposed to be written. For instance, he uses about five pages to explain the theory of the ellipse of elasticity. The little he says is true enough; but it is far from sufficient to help anyone who, having some knowledge of the theory, is looking for help and a clarification of his ideas; it is almost needless to say that the designer who is familiar with that theory finds those pages quite useless. This defect is repeated in most of the other theories sketched out in this part of the book.

Part III, on the design of reinforced-concrete structures, is perhaps the best part of the entire book. The various cases and types of single-span beams, multiple-span beams, T-beams, centrally and eccentrically loaded columns, etc., are described and discussed. It closes with many formulas and several tables which are useful for a ready computation of stresses in most of the cases occurring in the practice of designing beams, under the aforesaid conditions.

Part IV is a collection of many formulas useful to the designer; especially those concerning monolithic frames, made up of beams and posts and constituting a structure of one or more panels, horizontally and vertically. The author does not seem to have been very diligent in presenting his scientific material. For instance, there are several diagrams, inserted in this last part of his work, most of which deal with graphical methods to be used for finding the position of the neutral axis in a combined section of concrete and steel, under different hypotheses of loading. These methods, which originated with Wayss and Freytag, Christophe, Guidi, Canevazzi and some others, are very useful. They are explained in every other book which quotes them, but not in this one, where the diagrams are inserted without one word of explanation, other than the heading. Yet among these graphs there are some which certainly need verbal explanation; for instance, Guidi's method for the determination of the position of the neutral axis in a compound section, subject to an eccentrical load.

In closing, a remark will be made which is considered applicable not only to this book but also to Italian and German scientific publications generally, in contrast to the French and English publications. In the first group, the authors seem concerned more in showing their learning than in explaining clearly their subject; the reverse is true, generally speaking, of the French and English publications. It seems that both the Italians and Germans, and especially the latter, miss the main point, which is that they are writing to explain things to readers who are, at best, not so conversant with the subjects as the writers themselves.

Artistic Bridges Through the Centuries

BRIDGES: A Study in Their Art, Science and Evolution, Illustrated with Photographs and Drawings of Old and New Bridges in Many Lands. New York: William Edwin Rudge. Cloth; 10x12 in.; pp. 36; 400 illustrations, mostly halftone views. $20.

WITHOUT belittling the engineer or putting the architect on too high a pedestal, the author of this book recognizes the fact that in bridge design either the two professions must be combined in one person or else members of the two professions must join forces if the highest ideals are to be attained. Which of these combinations the author considers best may be inferred from his foreword, where he pleads for "thorough architectural training of the civil engineer" so that "his tremendously important works may be inspiringly beautiful as they are economically sound."

The book is in two parts: (I) Art and Science in Bridge Design and (II) Influence of Material on Bridge Forms. Each part opens with a pertinent general discussion. Part I is arranged chronologically—Roman, Dark Ages, Rennaissance, Eighteenth Century, and Modern; Part II is arranged by materials of construction, also somewhat chronologically — Wood, Stone, Concrete, Steel. Most of the esthetic fundamentals are outlined in the opening section of each part, chiefly in Part I. These fundamentals are further emphasized in the running comment on the illustrations to Part I, but fall off in Part II until, after the opening section, they cease—as does also the text. Why the text should thus dwindle, then suddenly end, the author does not explain. Critical comments on the esthetic strength and weakness of the various bridges of the modern period seem to be essential to the purpose of the author and would have been of great possible help to users of the book—although it might have landed the author in the hot waters of controversy. To fulfill its purpose such a book should contain a few horrible examples, but this volume has none; at least none so indicated or that so strike the eye without being pointed out.

Unfortunately, the index to the book is limited to reference to specific bridges. This is less serious than it would be were the text more extensive than it is.

As an example of book manufacture the book is notable. The hundreds of halftones, which constitute so large and important a part of the volume, are of the best, as are also the typography and press work. The binding is as serviceable as it is pleasing to the eye, which is far more than can be said of many books primarily concerned with art and supposedly intended for frequent handling.

The Future Plan of Paris

REVIEWED BY HAROLD M. LEWIS

Executive Engineer, Regional Plan of New York and Its Environs

L'AVENIR DE PARIS: Urbanisme Français et Urbanisme Américain—La Beauté de Paris en Danger—L'Extension—La Circulation—L'Industrie et Paris Port de Mer—La Charte de Plus Grand Paris—By Albert Guérard, Professor à la Faculté des Lettres de l'Université Stanford, Californie, Chargé du Courts de Civilisation Française. Préface de M. Paul Bouju, Préfet de la Seine. Paris: Payot, 106 Boulevard St. Germain. Paper; 5½x9 in.; pp. 366. 30 francs.

THIS book on the future of Paris by M. Albert Guérard, professor at Leland Stanford University and a "Parisian of Los Angeles," should be of interest to city planners and all those who are interested in the city of Paris.

One might expect that the author would propose the application of American standards to the Paris plan, but quite the reverse is the case. Paris is described as on the eve of a transformation which, in its magnitude, will surpass the work of Haussmann. Since 1910 it has been obvious that something must be done to provide for its future growth. In 1913 a commission under M. Delanney prepared a report on Considérations Techniques Préliminaires for the establishment of a plan of extension. Then came the war and the long period of reconstruction and readjustment; now French public opinion is aroused and commissions of all kinds have been created and the vital questions have been confused.

M. Guérard issues a warning against any extreme replanning of old Paris. He decries the spirit of geometry in the planning of Le Corbusier and prefers Baudelaire's acknowledgment of the "profound and complicated charm of a capital aged and out of date in the glories and tribulations of life." He believes that the expression of a city's individuality and traditions are far more important than the geometry of its design.

The modern American is described as a caricature of the moment rather than of the race. American cities are beginning "to see the light," as shown by their modified skyscrapers, their boulevards and public buildings and their departure from rectangular street systems. Social service is now the watchword. "The city is civilized. We have the right to hope."

M. Guérard would treat the old city of Paris differently from the growing areas in its environs. He points out that Paris is a city of the living and not an archeological museum. It is primarily a city of proportions and of harmony. The verdure of its boulevards is a precious heritage almost indispensable to the classic styles of the seventeenth and eighteenth centuries. He urges that any plan of extension should include ample provisions for wooded parks and tree-lined boulevards and parkways. Between the Cité and the Champ-de-Mars the beauty of the Seine must be preserved at all costs.

The skyscraper is described as a plague; not a New York invention but one dating back to the eighth and ninth centuries. He does not oppose skyscrapers in the environs of Paris, but says they should never be permitted in the old Paris, where seven stories is now the maximum. He believes it would be better for the trees, streets and historical monuments if private construction never exceeded four stories in height, but proposes this as an ideal rather than a practical limitation.

Having pointed out the dangers that threaten the city, he proceeds to present his ideas of a plan for the future. Paris seems at present to have reached a point of saturation in its population, while the surrounding parts of the Department of the Seine are growing rapidly. Paris, as well as other large cities, has its slum problems. He would establish housing regulations based strictly on health and esthetics, requiring new buildings to conform at once to such regulations and giving the owners of old ones ten years to make them conform without indemnity; otherwise they would then be subject to a special tax. With the proceeds of this the city would condemn the worst areas and rebuild them. The remaining slums would gradually depreciate so that owners would rebuild them to avoid the tax.

The establishment of use zones similar to those provided in American zoning ordinances is proposed. It is pointed out that the habits of its residents affect the size of the region; if the Parisian continues to take his midday meal at home he must make four trips daily in place of the American's two. He hopes the Parisian habit will not be altogether abandoned. A co-ordinated system of public transport and utilities is recommended and it is stated that Paris should proceed at once to reorganize its transportation system rather than to wait for future growth. A separate commuter system on its railroad lines, distinct from the "Métro," or rapid transit system, is proposed.

A large part of the book is devoted to the industrial future of Paris and its potentialities as a maritime port. Professor Guérard believes that Paris is destined to become one of the industrial centers of a more active Europe and that provision should be made for industrial growth confined to its proper zones. He urges the construction of a ship canal to tidewater and believes that the consummation of such a plan has been prevented by timidity rather than by nature. He recommends that such a canal should be crossed by fixed bridges for railroads and the most important highway routes with a clearance of 22½ meters (about 75 ft.).

The political organization of the Paris region is also discussed. A metropolitan council is proposed to carry out projects of metropolitan importance, leaving local affairs for local councils.

Tricks of the Trade

ELEMENTS OF TOPOGRAPHIC DRAWING—By Roscoe C. Sloane, C.E., Professor of Highway Engineering, Ohio State University, and John M. Montz, B.S. in C.E., Assistant Professor of Civil Engineering, Ohio State University. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 188; 93 illustrations. $2.75.

"PRACTICE makes perfect" is an aphorism much quoted in the teaching of engineering drawing. Proficiency in this art certainly requires hours of practice, but it is equally true that intelligent instruction can prevent the waste of much misdirected time and energy. The authors of this book, as the result of several years of teaching, have assembled many useful hints in practical draftsmanship which should aid greatly in the production of useful and artistic maps. While intended primarily for the student, the text will undoubtedly help the experienced draftsman in improving his product. Even chief draftsmen need to be reminded, for example, that the drawing of a good map "is as much a matter of composition as the writing of a beautiful sonnet or the arranging of the notes of the musical scale into a pleasing symphony." Furthermore, the book serves as a convenient source of reference for standard symbols used in general mapping, as well as in hydrographic, municipal, railroad and military topography. In addition, it includes samples of lettering and a list of accepted abbreviations, as well as chapters on methods of reproduction and on office practice.

Of Twofold Importance

TESTS OF LARGE TIMBER COLUMNS and Presentation of the Forest Products Laboratory Column Formula—By J. A. Newlin, Principal Engineer in Charge and J. M. Gahagan, Assistant Engineer, Section of Timber Mechanics, Forest Products Laboratory, Branch of Research, Forest Service. Technical Bulletin No. 167. Paper; 6x9 in.; pp. 44; line cuts, halftones and tables. 15c. from Superintendent of Documents, Washington, D. C.

BESIDES reporting tests on some of the largest and longest timber columns yet studied, this bulletin presents the first comprehensive demonstration of the use of the new Forest Products Laboratory timber column formula. The test specimens consisted of 160 12x12-in.x24-ft. timbers covering the entire range in density and knots of Southern pine and Douglas fir timbers cut for commercial uses. The tests included: (1) preliminary stiffness tests made by applying a relatively light load in bending over a 200-in. span; (2) compression tests of 24-ft. columns; (3) compression tests of intermediate columns, 8 to 13 ft. long; and (3) compression tests of short columns 2 ft. long. The long and intermediate columns were tested under pin-ended bearings and the 2-ft. columns under square-ended bearings. One important result reported is that knots do not seriously affect the stiffness of timbers, columns or joists, so that for members in which stiffness rather than strength is the controlling factor, such as posts in small dwellings, it is entirely safe to use knotty material. The results showed also that for intermediate columns, which depend for their efficiency on a combination of stiffness and crushing strength, the Forest Products Laboratory formula applies consistently, indicating that its employment in design by engineers and architects would eliminate the use of needlessly high factors of safety in timber column design, with resultant economy.

Monographs on Group Home Planning

NEIGHBORHOOD AND COMMUNITY PLANNING: Regional Survey, Vol. VII—Comprising Three Monographs: The Neighborhood Unit, by Clarence Arthur Perry; Sunlight and Daylight for Urban Areas, by Wayne D. Heydecker, in collaboration with Ernest P. Goodrich; Problems of Planning Unbuilt Areas, by Thomas Adams, Edward M. Bassett and Robert Whitten. New York: Regional Plan of New York and Its Environs, 130 East 22d St. Cloth; 9x11 in.; pp. 363; 122 line cuts, halftones and folding plates.

OF THE many useful volumes constituting the Regional Survey of New York and Its Environs, this should have the strongest appeal to the people of the region, for it deals with group home planning. This it does in three monographs dealing with (1) the neighborhood unit, (2) sunlight and daylight, and (3) planning unbuilt areas.

Significant of the times is the fact that one of the proposals in the first monograph is for a five-block neighborhood, housed in a building providing not merely homes for a thousand families but also stores, an elementary school and a central garden. Here and elsewhere in the volume recognition is given to the motor vehicle and the streets which it congests as a factor to be reckoned with in city housing. The monograph on sunlight and daylight is one of the most important contributions to urban planning in all the publications of the Regional Survey. It summarizes the reasons for sunlight and daylight planning and goes rather deeply into the graphics of the subject. The final monograph, on planning unbuilt areas, is applicable not only to the large portion of New York City as yet not built up but also to the large rural and semi-rural areas in the various satellite cities and towns and the still larger rural areas lying between them but becoming more urban every day. Various legal aspects of subdividing land are considered in this monograph.

Although concerned primarily with New York and environs, the highly diversified character of the region, including cities, and towns and villages of all sizes and sorts, besides great rural tracts, makes the volume of appeal to city and regional planners everywhere, whether in this or in other countries.

Comprehensive and Readable

AMERICAN CITY GOVERNMENT AND ADMINISTRATION—By Austin F. MacDonald, Ph.D., Assistant Professor of Political Science, University of Pennsylvania. [Crowell's Social Science Series, edited by Seba Eldridge, University of Kansas.] New York: Thomas Y. Crowell Co. Cloth; 5½x8 in.; pp. 762. $3.75.

IN A single volume the author covers both city government and city administration, carrying the latter into the organization of departments and also their work, such as paving, water supply and sewerage. So broad a treatment, even when extending to more than 700 pages, cannot be deep or detailed, but fundamental principles and a fair general idea of leading practices are well presented. The space is about equally divided between government and administration. The scanty space and other limitations on the treatment of engineering subjects result in some misleading statements, but they are not serious. They are more excusable than conveying the idea that the Board of Aldermen of New York City has any material part in the government of the metropolis. The author deserves commendation for presenting so comprehensive a survey in so readable a manner.

Central Lighting by States

ELECTRIC POWER AND LIGHT COMPANIES of the United States, The Bonbright Survey of. Revised to December, 1929 [financial statistics as of Sept. 30, 1929]. Arranged according to Geographic Divisions. Sixth Edition—Edited by G. F. Wittig, Statistical Editor, *Electrical World*. New York: McGraw-Hill Publishing Co. Paper; 8½x11 in.; pp. 196; maps and tables. $10.

WITHIN its set limits—and they are well planned—this is a remarkable volume. A table and a map for each state of the Union show places of 2,500 population and upward having electric light and power supply. Symbols denote plants privately and also municipally owned, the former by name of operating companies. For each state there are concise data on its main industries, population, number of telephones, automobiles, electric light consumers, primary horsepower (all kinds and electric) value of crops, and, for manufacturing establishments, total number and average number of wage earners and value of manufactured products; also a summary, by operating companies only, of capitalization and earnings. There is a long list of holding companies and their subsidiary companies. A one-page table shows the number of central-station customers by states, groups of states and the United States for the past three years, under domestic lighting, commercial lighting, power and miscellaneous (from *Electrical World*, Jan. 4, 1930). A few pages of introductory text, with impressive statistical summaries in the margins, give a general review of the growth of the industry since its inception.

A summary of the number of places included, by states and geographical divisions, with the division of ownership into private and municipal, would have required little work or space. One person's work for a short time would have answered questions that will arise in the minds of many users of the Survey.

Publications Received

TRIANGULATION in Hawaii and also in Colorado make up Special Bulletins 156 and 160 of the U. S. Coast and Geodetic Survey (pp. 240 and 70; 50c. and 15c. from Superintendent of Documents, Washington, D. C.).

RESEARCH STUDIES issued as Bulletin No. 8 of the School of Engineering Research, University of Toronto (Ont.) are classed in 21 sections, among which are: Venturi Meter Coefficients and Friction Loss in a 14-In. Tee, by Robert W. Angus; Uniflow Steam Engine, by E. A. Allcut; Elastic Catenary Applied to Base Measurement, by L. B. Stewart; and Permissible Stresses on Rivets in Tension, by C. R. Young and W. B. Dunbar.

ELEVEN REPRINTS of Articles Pertaining to the Sewerage System of Baltimore City comprise the third bulletin of this character published by the Bureau of Sewers, Baltimore, Md. Among the articles are: Maintaining Baltimore's Sewers, by Milton J. Ruark; Fertilizing Value of Baltimore Sewage Sludge, by C. E. Keefer and G. K. Armeling; and Friction Loss in a 42-In. Sewage Force Main at Baltimore, by C. E. Keefer and R. T. Regester.

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

AMERICAN CHARITIES AND SOCIAL WORK—By [the late] Amos G. Warner, Stuart A. Queen and Ernest B. Harper. Fourth Edition. New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp 616. $3.75.

With some condensation for the sake of brevity, the late Professor Warner's American Charities, as published in 1894, is here printed as a picture of the practice and ideals of that date, while new material deals with present-day conceptions and usages of social work. A new Introduction gives a historical perspective. One of the new chapters takes up Social Work in Industry; another, Recreation.

AMERICAN CIVIL ENGINEERS' HANDBOOK—Editor-in-Chief, Thaddeus Merriman; Associate Editor-in-Chief, Thomas H. Wiggin. Fifth Edition, thoroughly revised and enlarged. New York: John Wiley & Sons. London: Chapman & Hall. Flexible; 4½x7 in.; pp. 2263; line cuts and tables. $8—or in two volumes, $10.

DER AUFBAU DES MORTELS und des Betons: Untersuchungen uber die zweckmässige Zusammensetzung der Mörtel und des Betons. Hilfsmittel zur Vorausbestimmung der Festigkeitseigenschaften des Betons auf der Baustelle. Versuchsergebnisse und Erfahrungen aus der Material-prüfungsanstalt an der Technischen Hochschule Stuttgart—Von Otto Graf. Dritte, neubearbeitete Auflage. Berlin: Julius Springer. Paper; 6½x9½ in.; pp. 151; 160 illustrations. Paper, 16M; bound, 17.5M.

Third edition, revised, of a monograph first published in 1922. Deals with make-up of cement-mortar and concrete.

BERICHT UBER DIE ZWEITE INTERNATIONALE TAGUNG für Brückenbau und Hochbau. Vienna: Julius Springer. Paper; 7x10 in.; pp. 790; 597 illustrations. 36 Rm.

In this report of the Second International Congress for Bridge and Structural Engineering, each paper is printed in the language of its author: 49 in German, 16 in French, and only 1 in English, the latter on Impact in Highway Bridges, by Almon H. Fuller.

BUILDING ESTIMATORS' DATA BOOK—By Charles F. Dingman, Architectural Engineer. First Edition. New York and London: McGraw-Hill Book Co. Flexible; 4x7 in.; pp. 159; line cuts and tables.

A reprinting of the edition favorably noticed in this section June 20, 1929, p. 1005.

FLOOD FLOWS: A study of Frequencies and Magnitudes—By Allen Hazen, Sc.D., Civil Engineer, M.Am.Soc.C.E. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 199; illustrations and tables. $4.

MACHINE-MADE MAN—By Silas Bent, Author of Ballyhoo, The Voice of the Press. Woodcuts by H. Glintenkamp. New York: Farrar & Rinehart. Cloth; 6x9 in.: pp. 341. $3.50.

PRACTICAL MECHANICS AND STRENGTH OF MATERIALS—By Charles Wilbur Leigh, B.S., Professor of Analytic Mechanics at Armour Institute of Technology; Coauthor, Palmer & Leigh Plane and Spherical Trigonometry; and John Frederic Mangold, C.E., Associate Professor of Mechanics at Armour Institute of Technology and Licensed Structural Engineer. Second Edition. New York and London: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. 420; 397 illustrations. $2.75.

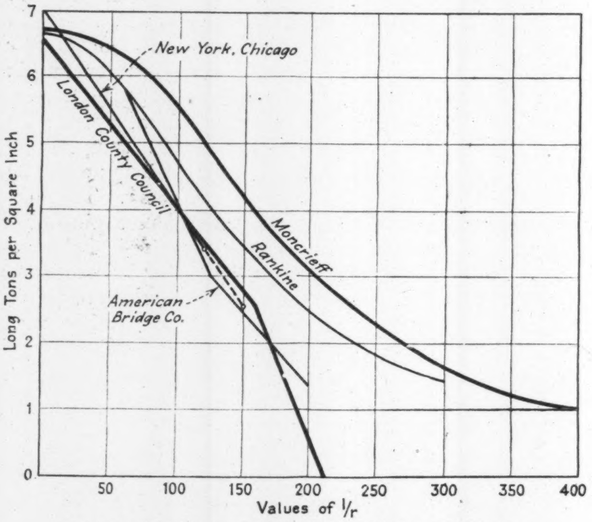
RHYTHMIC CORRUGATIONS IN HIGHWAYS—By Homer J. Dana, Washington State Highway Department. Engineering Bulletin No. 31. Pullman: State College of Washington, Engineering Experiment Station. Paper; 6x9 in.; pp. 30; 20 line cuts and halftones.

Letters to the Editor

"Structural Awakening Abroad"—A Protest

Sir—Your article "Structural Awakening Abroad," Feb. 20, 1930, p. 309, containing as it does a serious reflection on British engineers, cannot be allowed to pass unchallenged. Far from there ever having been a period of somnolence, careful inquiry will prove the reverse, to which end the following notes may be of interest.

1. Office floor loads in the London County Council area may be taken at 80 lb. per square foot upon written intimation of this being done.
2. Steel may be stressed to 8 tons per square inch, which compares with the New York figure of 7.14 tons (long tons understood.)
3. The London County Council column formula is by no means so conservative in comparison with the New York formula as Mr. Bowers would have us believe, as the attached curves will show.



COMPARATIVE COLUMN-FORMULA CURVES
Moncrieff formula generally used in England; London County Council formula governs in London area only.

Finally, the unfairness of putting forward the rules adopted by the London County Council as representative of the practice in the whole country must be readily apparent when it is remembered that this body controls only part of London and has no jurisdiction whatever over any other area, in which stresses 30 per cent higher are common.

The above set of curves tends to corroborate the claim advanced in the first paragraph and would seem to indicate that the title of your article should at least not appear in an American book.

Undoubtedly much can be gained by exchange of views, which is welcomed, but no useful purpose will be served by inaccurate figures on either side, which is the excuse for this entry upon your columns by

London, England, THREE PRACTICAL DESIGNERS.
March 26, 1930.

News of the Week

Supreme Court Affirms Hughes Report on Chicago Diversion

Chicago must finally complete its sewage disposal system by 1938, and on that date reduce its diversion from Lake Michigan to 1,500 sec.-ft. in addition to domestic pumpage, by the terms of a decision handed down April 14 by the U. S. Supreme Court. This, in general, confirms the findings of Special Master Charles Evans Hughes, now Chief Justice of the court, who took no part in its action. An abstract of this report appeared in our issue of Dec. 19, 1929, p. 983, and was discussed editorially Dec. 26, p. 993.

The decision is the final result of a long controversy between the State of Illinois and the Sanitary District of Chicago and the states bordering on the Great Lakes. A decree will now be entered by the Supreme Court formally stating the conditions which the city must meet. Full details of this decree will be given in a subsequent issue.

New York Tunnel Construction Advanced by Legislation

Approval of five bills by the legislature and Governor of New York State consolidating the Port of New York Authority and the New York State Bridge and Tunnel Commission provide for uniform control by the Port Authority over the Holland tunnel, the Fort Lee bridge, the proposed midtown tunnel under the Hudson River at 38th St., Manhattan, and other traffic facilities in the New York region. All five acts will take effect upon the approval of similar legislation by the State of New Jersey. The number of commissioners composing the Port Authority is increased to twelve, six from each of the states concerned. One of the bills approved contains an appropriation of $200,000 for New York's share of the cost of investigating and reporting upon the midtown vehicular tunnel. Similar legislation has been passed by the State Legislature of New Jersey and now awaits the Governor's signature.

Approval has also been given to a measure authorizing the New York City Board of Transportation to plan and construct tunnels between boroughs of the city or between points within a single borough, making it possible for this board to construct the proposed Narrows vehicular tunnel between Brooklyn and Staten Island and the East River tube connecting 38th St. with Brooklyn and Queens, as well as the proposed crosstown extension westward to connect with the Hudson River tunnel. Formerly supervision of such projects was under the Department of Plant and Structures, but it was desired to place all tunneling work under the Board of Transportation in view of its extensive experience in subway construction. Plans for the projects named are already in preparation by the Board of Transportation, which has been technically working under the Department of Plant and Structures pending authorization of the change.

NEW SKYSCRAPER ON A FAMOUS SITE

At the corner of Broadway and Wall St., two of New York City's most famous arteries, the Irving Trust Co. is constructing a 50-story office building faced entirely with limestone and granite, the highest in the world of this type of construction. Steel design and erection are complicated because the setbacks do not fall on column lines. An interesting architectural feature is the arrangement of the stone facing in curved vertical planes to give the walls the effect of a drapery of stone. Voorhees, Gmelin & Walker are the architects. Marc Eidlitz & Son, Inc., is general contractor, with Post & McCord erecting the steel. The Foundation Co. was subcontractor on the foundations, which required surrounding the site with pneumatic caissons. This picture, taken April 1, looks down Wall St. past the spire of Trinity Church.

Earth Dam on Island of Kauai Collapses Before Completion

The Alexander dam, a hydraulic fill structure being built for the McBryde Sugar Co. on the Island of Kauai, on March 26 had reached a height of 95 ft., 30 ft. below the proposed crest level, when the structure collapsed and is reported a total loss. No flood followed the accident, because stored water was retained by a separate structure on the upstream side.

The sluicing of material into this structure had been in progress for some eighteen months, a chemical treatment being used on material put into the core. Unofficial reports on the cause of the slump indicate that the core material had never dried out and the pressure of the semi-liquid mass, aided by a ten-day rainfall, caused the lower slope to bulge, whereupon within a few seconds the entire central part of the dam flowed out as a river of mud, smothering six laborers at work below the dam. After inspecting the collapsed dam directors of the McBryde Sugar Co. authorized its reconstruction.

Sewer Failure in Detroit to Be Investigated

Following much political accusation and furore in Detroit over the failure of a section of the Southfield plain concrete sewer, the city council has authorized the appointment of a board of consulting engineers to report on the cause and extent of the failure. Francis C. McMath, C. Y. Dixon and G. G. Wrentmore were named to this board, but as it is reported that at least two of these men have declined to serve, the personnel of the board is still uncertain.

Pending the unwatering of the sewer nothing definite can be more than guessed at, but much political capital has been made of the occurrence and John W. Reid, commissioner of public works, has been replaced by a nontechnical man with the sewer failure as the excuse for letting out Mr. Reid. The new commissioner, John Gillespie, immediately dismissed Perry Fellows, city engineer, who has appealed to the courts for an order requiring the commissioner to reinstate him or show cause for dismissal. Mr. Gillespie, the new commissioner, was formerly head of the surety company which bonded contractors on the collapsed sewer, and also of a reduction company handling Detroit's garbage.

The 6-mile sewer was laid in five sections by four different contractors. It runs through about 500 ft. of quicksand undisclosed by borings when the contracts were let. The engineers assume there is trouble only in these short quicksand sections. It is said that the contractors on this sewer made little or no money and importuned the city to change the specifications, which would have increased the cost several hundred thousand dollars. The city insisted on compliance with the contracts, the engineers figuring that if repairs had to be made the expense of rebuilding in such short sections could not possibly exceed a comparatively few thousand dollars.

Hog Island Sold to Philadelphia for Transportation Depot

Terms have been agreed to by the city of Philadelphia and the United States Shipping Board by which Hog Island, the great shipyard in Philadelphia which turned out 122 ships during and shortly after the World War, will be transferred to the city for $3,000,000. The contract provides for development of the property as a marine, air and rail terminal. Of the total area of 946 acres, 307 will be used for the airport, 70 for a seaplane base and the remainder for a marine-rail terminal. Approximately 13,000 ft. of waterfront will be available for docks and wharves.

Terms of sale require a down payment by the city of $450,000 and a guarantee that $500,000 will be expended at once in airport development. During the first ten years of the city's ownership 3 per cent per year will be paid on the unpaid balance of the principal as ground rental.

During the following ten-year period, or until the entire principal sum shall have been paid, this will be increased to 6 per cent.

Hog Island shipyard, built as an emergency measure during the war-time shipping shortage, established many notable records. Fifty shipways, built along the 2¼ miles of waterfront, turned out 122 ships with a total dead weight tonnage of 956,750. Within the yard were 82 miles of railway track and 36 warehouses. The largest number of employees at any one time was 36,350.

Breaking of Contracts Contested in Indiana

Whether city, county and state boards in Indiana, which have the power to make building and paving contracts, also have the power to break them at will is to be decided in a suit brought by the W. M. Birch Co. against the board of works, mayor, city controller and engineer, and the Andrews Asphalt Paving Co., of Hamilton, Ohio. The Birch company had been given a paving job by the board of works late last winter. When time came to start construction, a new board of works had taken charge and the contract was revoked, as well as sixteen other contracts let to other companies. Subsequently, the job formerly awarded to the Birch company was given to the Andrews company, named as co-defendant.

Setback Building Lines Favored by Los Angeles County

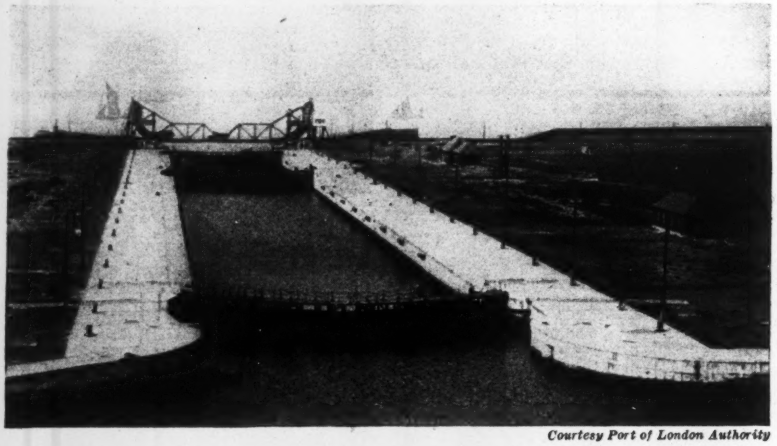
Los Angeles County, Calif., is seeking the co-operation of various municipalities within the county in the establishment of setback building lines on all major and secondary highways in order to avoid costly condemnation proceedings in connection with street-widening projects in the future. This plan was recommended by the County Regional Planning Commission. The board of county supervisors has issued an order for the preparation of the necessary ordinances establishing setbacks in county territory, and several of the municipalities have signified their intention to pass similar ordinances applying within their limits. It is estimated that this method will effect a saving in street-widening operations varying from $300,000 a mile on county highways to $1,000,000 a mile on city thoroughfares.

Building Conference Organizes on Permanent Basis

As the result of the recent Chicago meeting of the National Building Survey Conference (*Engineering News-Record*, April 3, p. 584), it has been decided that the conference, which came into being as a temporary organization, should be established on a more permanent footing to set up and formulate a national plan of action to stimulate building. Accordingly, a committee has been formed representing all varying interests within this sphere of construction which will select a larger committee from the building industry to draft recommendations for action. It has been tentatively decided to have the larger committee report to the Chamber of Commerce of the United States for the dissemination of final plans and calling of any further sessions that might seem necessary. Personnel of the organizing committee is as follows: Fenton B. Turck, Jr., chairman; Wilson Compton, National Lumber Manufacturers Association; Ernest A. Hale, United States League of Building and Loan Associations; Leonard Reaume, National Association of Real Estate Boards; Benjamin Afflick, Universal Atlas Portland Cement Co.; and William C. Cox, American Face Brick Association.

Study Subgrade Conditions at Ohio State University

The Engineering Experiment Station at Ohio State University is conducting a soil survey relative to road failure in charge of F. H. Eno, research professor of highway engineering, in conjunction with the U. S. Bureau of Public Roads and the Ohio Department of Highways. The program of the work includes: (1) standardization of the procedure for the testing of subgrade soils; (2) determination of subgrade conditions which influence heaving of pavements, variation in moisture content of subgrades and occurrences of road failures in Ohio; (3) relative efficiency of corrective measures for undesirable subgrade conditions.



Courtesy Port of London Authority

ENTRANCE LOCK LEADING TO TILBURY DOCKS, LONDON

Accommodations for the largest vessels afloat are offered at the reconstructed Tilbury docks of the Port of London Authority, briefly described in *Engineering News-Record*, Sept. 12, 1929, p. 429. Built at a cost of approximately $15,000,000, the improvements include a new entrance lock, dry dock, enlarged railway connections and 800 lin.ft. of quayage. The entrance lock, shown in the illustration, is 1,000 ft. long and 110 ft. wide, with a depth of 45½ ft. at high water. The three pairs of steel lock gates are of the flotation type, the lock being divided into two compartments, 700 and 300 ft. in length. Foundations reach a maximum depth of 70 ft. below quay level. Sidewalls of both entrance locks and dry docks were built by sinking concrete monoliths from 25 to 35 ft. square, built up of dovetailed blocks on a base or cutting shoe of reinforced concrete. These were weighed down by cast-iron blocks while excavation was carried on within the four walls.

Salt Lake City to Vote on $3,000,000 Water Bonds

Extensions to the water supply of Salt Lake City, Utah, involving an amount not exceeding $3,000,000, will be voted upon at a special election to be held May 6. The largest proportion of this amount, $2,300,000, would be utilized for constructing the Argenta dam and reservoir, including the purchase of necessary land. The rest of the money would be used for the construction and rebuilding of distribution reservoirs and of supply mains and conduits.

Highway Safety Meeting Called

The third National Conference on Street and Highway Safety will be held in Washington May 27-29. The conference is for the purpose of considering measures and remedies for the traffic congestion and accident situation and assisting the different states and cities in their efforts for uniformity of laws and traffic regulations. The governors of all of the states are being invited to designate official delegates to the conference. It is expected that unofficial authorities, business and civic organizations and other bodies concerned with various phases of traffic will be officially represented by delegates.

Program Announced for St. Louis Meeting of A.W.W.A.

Many subjects of interest to members will be discussed at the annual meeting of the American Water Works Association, scheduled for St. Louis, Mo., June 2-6. The first day, Monday, June 2, will be taken up with a meeting of the governing board, a round-table discussion for plant managers and superintendents, and a meeting of the committee on standard methods of water analysis. Main sessions of the convention will start Tuesday morning, June 3, with the regular business meeting. As part of this session, Jack J. Hinman, Jr., president of the association, will give a review of 50 years of growth of the society. Further sessions to be held during the week will hear a total of 27 papers on various phases of water-works practice. In addition, simultaneous sessions will be held by the water purification division, before which seventeen additional papers will be presented. These will continue until Thursday, after which the finance and accounting division will, on Friday, hold two sessions, at which will be presented a series of papers and discussions of interest to water-works accounting officials.

Other features of the program include a conference of the committee on boiler feed-water studies, to be held Tuesday afternoon, June 3, and a number of social events, as well as an inspection trip to the new Howard Bend plant of the city of St. Louis, which will take place Wednesday afternoon, June 4.

The Business Outlook

Steel-mill activity declined somewhat after last week's upturn. The average dropped from 76 per cent to 75, compared with 96 a year ago, due to falling off in the Steel Corporation. Automotive demand continues slack. Prospects of sustained railroad demand are not considered bright, because of curtailed rail earnings. Oil and gas pipe and shipbuilding demand are the strongest sustaining factors. The preliminary estimate of March car and truck production in the United States and Canada is about 400,000, 17.8 per cent over February but 36.1 below last March. Bituminous coal production showed a sharp increase for the week, contrary to the usual seasonal trend.

—The Business Week, April 16.

Marine Power Plant to Serve New England Coast

Under arrangements recently completed with the Shipping Board, the New England Public Service Co., of Augusta, Me., will take over a laid-up cargo vessel for the purpose of converting it into a floating power plant. The vessel will be used to supply power to coastal cities in Maine and New Hampshire where land power facilities are not available. It will be necessary to spend $1,000,000 to install the power equipment in the boat.

Specifications that have been drawn to cover the project call for the installation of two 10,000-kw. steam turbo-generators of the oil-burning type and four high-pressure water-tube boilers. The New England Public Service Co. has agreed, under the terms of the contract, to scrap all machinery and equipment not useful to the vessel after conversion. The vessel is of 7,668 deadweight tons, and is approximately 425 ft. in length. It is stated that the price obtained by the board is $8,000 more than the estimated scrap value.

To Build Grain Elevator on Hudson Bay

Tenders for a 2,500,000-bushel grain elevator at Fort Churchill, the terminus of the Hudson Bay Railway, have been called for by the Department of Railways and Canals of the Canadian government, the tenders to be submitted by May 13. It is planned by the department to have this elevator completed by Sept. 13, 1931, in time for the handling of next year's crop. As from 600 to 800 ft. of deep water dock will have been constructed by that time, it will be possible to load ocean ships at the elevator.

Railroad Extension Approved

The Chesapeake & Ohio Railroad has been authorized by the Interstate Commerce Commission to complete construction of its Marsh Fork extension in the Coal River district of West Virginia by building a line from Edwight southeast to a connection with its Piney Creek branch at Surveyor, 19 miles. Tributary to the route of the proposed line are extensive deposits of both high-volatile and low-volatile bituminous coal. The Virginian Railway opposed the project, contending that the principal objective of the C. & O. is to pre-empt the low-volatile areas lying to the west of its line at Surveyor and logically falling within territory which ought to be developed by it at the proper time. Cost of construction of the single-track line, laid with 100-lb. rail, is estimated at $2,377,470.

Student Bridge Prizes Awarded

Three students at the University of Illinois won the three cash prizes of 1930 offered by the American Institute of Steel Construction for the most beautiful design of a steel bridge submitted by architectural students. These prizes, amounting to $500, $250 and $100 respectively, were made through the Beaux-Arts Institute of Design. A total of 160 students enrolled in the competition and submitted sketches in the preliminary judging. The problem called for a design of a steel bridge of 650 ft. in length with a main arch span of 325 ft. The prizes were awarded in the final judging to George D. Recher, first; Russell O. Deeter, second, and Don P. Ayres, third, all of the University of Illinois.

Association Organized to Study Underground Pipe Protection

As the result of a recent meeting in Tulsa, Okla., attended by representatives of eleven leading manufacturers of materials for protecting underground pipes against corrosion, an association known as the Underground Pipe Protection Institute has been formed to create a medium through which the members may establish relations with organizations studying methods and economics of pipe protection; to promote a better understanding of such problems; to establish friendly relations with members of technical societies interested in the subject; and to establish and encourage ethical practices in the industry. Officers of the institute are as follows: president, K. M. Converse, Dearborn Chemical Co., Chicago; vice-president, E. S. Browning, Hill, Hubbell & Co. Division, General Paint Corporation, Chicago; secretary-treasurer, W. H. T. Thornhill, Wailes Dove-Hermiston Corporation, New York. These officers, together with R. V. Rinehardt, Johns-Manville Corporation, New York, and William H. Kershaw, Texas Co., New York, constitute the board of directors.

Brief News

The 50th Anniversary of the completion of the St. Gotthard tunnel was recently celebrated in Switzerland. The bore has a length of 14,998 meters and was the longest in the world for 25 years after its completion.

Parking Space for 400 cars will be provided in a fourteen-story office building to be erected in Montreal at a cost of $1,500,000.

Ratification by the Greek Senate of a contract for preparing land reclamation and irrigation plans to be undertaken in that country by Henry Boot & Sons, Sheffield, England, assures an immediate start on this $30,000,000 undertaking. A general description of the proposed work was given in *Engineering News-Record*, Feb. 20, 1930, p. 341.

The Hydro-Electric Power Commission of Ontario has entered into an agreement with the Dominion Power & Transmission Co., Ltd., for the purchase of its properties and subsidiary companies for $21,250,000. The agreement must be ratified by the stockholders of the Dominion company.

Test Borings for the $15,000,000 highway toll bridge between Pablo Point, Contra Costa County, Calif., and Eels Point, Marin County, have been started by the Duncanson-Harrelson Engineering Co., of San Francisco.

Dwellings of Fireproof Wood are being erected in France by a German concern as part of the reparation payment. Each month 100 five-room houses of this type are being erected at a fixed price of $1,500 each.

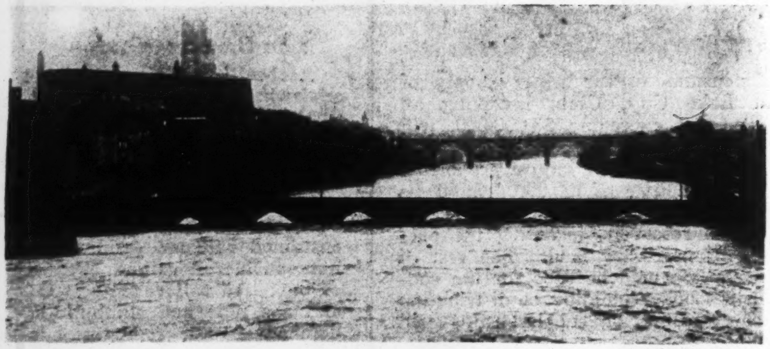
Building Height Limits in Kansas City have been modified by the City Plan Commission to permit the construction of two proposed tall structures, the 30-story Kansas City Power & Light Co. Building and the 26-story Bryant Building.

Damages for a Grade Crossing Accident in which a motor truck caused the wrecking of a train must be paid by the owner of the truck to the railroad, according to a recent court decision in Illinois. The railroad sued the truck owner for $30,000 damages and was awarded $10,000. An appeal for a new trial has been denied.

Contract for a new railroad bridge and track elevation work in Pittsburgh has been awarded by the Baltimore & Ohio Railroad to the Vang Construction Co., of that city, at an estimated cost of $500,000.

Constantinople, Turkey, will soon call for bids for the construction of a $9,000,000 bridge across the Golden Horn.

A Bill designed to place both privately owned and municipally owned water-works in New York State under the control of the Public Service Commission was amended in the State Legislature to apply to privately owned works only, and then failed of passage in the concluding hours of the session due to an oversight.



Wide World Photo

WHEN MARCH FLOODS INUNDATED SOUTHERN FRANCE

Heavy rainfall early in March brought many rivers in the southeastern section of France to an unprecedented height, as is shown by this view of what is said to be the oldest bridge in France, at Albi, not far from Toulouse. More detailed information in regard to these floods appears on p. 647.

San Francisco has a new office building, the 29-story Shell Building, recently completed at a cost of $4,000,000. Parking space for 175 cars is provided by a four-floor garage within the building.

A Water-Works Short Course will be given May 11-15 at the Oklahoma A. & M. College, Stillwater, Okla.

City Manager Government was rejected by Owosso, Mich., on April 7, by a vote of 526 to 1,161.

Seven New Hydro-Electric Plants in the Ruhr district of Germany are planned, to be completed by 1934.

Kentucky Will Map about 30,000 square miles of its territory for the first time during the next three years. The State Legislature and the federal government have each appropriated $200,000 for this purpose.

Engineering Students at North Carolina State College, Raleigh, have organized the Construction Engineering Society and have made application for a charter as the first student chapter of the Associated General Contractors of America.

Homestead Lands Held Exempt From Special Assessment

That a valid, binding lien for street paving cannot be created against homestead property in Texas is stated in a decision recently rendered by Chief Justice C. M. Cureton, of the Supreme Court of that state. The case is styled City of Wichita Falls, for L. E. Whitman & Co., vs. Williams et al. The decision holds that a special assessment for paving or other improvements is not an annual tax as contemplated by the State Constitution, and that homestead property is subject to liens only for annual taxes.

Centralia to Complete Municipal Hydro-Electric Project

As the final step toward completion of its municipal hydro-electric power project on the Misqually River, the city of Centralia, Wash., has called for bids on the construction of a 25-mile transmission line, a concrete power house, a substation, a forebay and a flume over Yelm Creek. Estimated cost of this construction is $400,000. The project will ultimately produce 11,000 hp. and will tie up with the municipally owned electric distribution system.

Maps Issued Showing Status of Federal-Aid Highways

Revised progress maps of the improvement of the federal-aid highway system, issued recently by the U. S. Bureau of Public Roads, show not only the condition of that system in each state but show also the system of U. S. highways designated by numbers corresponding to the numerals displayed on the shield-shaped route markers now erected in practically all states. These maps are in no sense touring maps, but they will be of value to the motorist planning a trip over the federal-aid system or over the U. S. highway system. Symbols indicate the type of surface on all parts of the system, and show whether the improvements were made with or without the assistance of the federal government. The maps are drawn to a uniform scale; sheets are of uniform size and are so bound that they may be punched and placed in a loose-leaf atlas. The number of sheets for each state ranges from one to six. A few of the smaller and adjacent states are grouped on one map, such as Maryland and Delaware; Massachusetts, Rhode Island and Connecticut; and New Hampshire and Vermont. Maps may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10c. a sheet. There are 112 sheets covering the 48 states.

WASHINGTON NOTES

By Paul Wooton

Washington Correspondent

Boulder Dam Contracts Still Unsigned—Appropriation for Rivers and Harbors Up Soon

PENDING signatures on power contracts under the plan announced last month, the Boulder dam issue still hangs fire. There have been further conferences in California to settle such matters as how the 6 per cent of the total power allocated among eleven municipalities is to be divided. Legal phases of the individual bids also are being adjusted. The completion of contracts which will guarantee the use of all power developed at Boulder dam seems to be only a matter of days.

A meeting of the Colorado River Board was held in Denver April 10 to consider Boulder dam plans formulated by Reclamation Bureau engineers since the last session five months ago. The project plans are well advanced, awaiting authorization to go ahead with the work. The Union Pacific Railroad is to build a spur line to the site, but is authorized by the Interstate Commerce Commission to delay this job until a definite date is set for the start of construction.

High Transmission Towers

In order to span the Mississippi with a 66,000-volt power line, the Baton Rouge Electric Co. has submitted plans to the War Department calling for two riverbank towers 427 ft. high. It is believed that these will be the highest structures of their kind in the world. The War Department will require that the line be 150 ft. above high water. The line will be used to connect the new Baton Rouge power plant with the Gulf States Utility system at Beaumont, Tex. The Baton Rouge plant is designed primarily to supply steam to the Standard Oil Company refineries. While the production of electricity will be incidental, it is understood that there will be a large amount of power for distribution throughout the Southwest.

I.C.C. Pushes Consolidation Plans

Prompting the Interstate Commerce Commission's order requiring the Wabash Railway and the Delaware & Hudson Co. to show cause why their applications filed last year for extending their systems should not be dismissed is the commission's desire to promote actual consolidation of the railroads. Both applications were filed under paragraph 2 of section 5 of the interstate commerce act, which permits acquisition of control by purchase of stock or lease that, although falling short of physical consolidation, serves the same purpose to a large extent. The Wabash previously had requested the commission to let its application remain on the docket, explaining that it was actively pursuing negotiations with other roads for the inclusion of desired properties within its system. Unless the Wabash is willing to consent to a dismissal, the effect of the commission's order probably will be to require the road to disclose how successfully these negotiations have progressed. The Wabash's original plan included the Lehigh Valley; Wheeling & Lake Erie; Pittsburgh & West Virginia; Western Maryland; Lehigh & New England; Akron, Canton & Youngstown; Elgin, Joliet & Eastern; Toledo, Peoria & Western, and the Chicago & Illinois Midland.

Beyond a formal acknowledgment, the Delaware & Hudson has never responded to the commission's initial suggestion in February that plans filed by the trunk lines prior to publication of the commission's plan last December should be withdrawn. While it would be possible to reconcile the plans of the Wabash and the commission, the proposal of the Loree company for uniting in a vast terminal system many of the roads serving the Atlantic ports was entirely ignored in the commission's plan.

Contract Wage Rates

The Sproul bill, designed to secure wages for workers on federal construction jobs equal to those paid in similar private construction work in the same locality, was reported to the House by the committee on labor on April 16. The report handed down by the committee calls attention to the large building program undertaken by the government and points out that recognition should be given to the important effect that the work will have on wage scales in the building industry. The government is in a strong position, and can use its strength to depress the prices of labor, or it can aid in maintaining existing rates, the report states. To carry out the terms of the bill, it is provided that a stipulation concerning wage scales shall be made a part of all future public building contracts. Any public contractor who pays less than the existing wage scale in the locality concerned is made subject to a fine. The bill carries a provision exempting its restrictions from applying to contracts already let.

Congress to Consider Waterway Expenditures

After discussing the pending rivers and harbors bill with the President, House leaders are convinced that he has no objection to the bill in its present form. It is understood, however, that the President does not want the amount authorized to go any higher. At present, the bill authorizes a total expenditure on the various projects of $108,000,000. Final approval has not been given by the committee and it is regarded as likely that this amount will be changed to a slight extent before the bill is brought up on the floor.

The present understanding is that the bill will be brought up in the House on April 23. Complete agreement as to when consideration can be given the measure is expected to be reached before that time. Senators from the Lake states are expected to oppose passage of the bill on the ground that the inclusion of the Lakes-to-the-Gulf waterway will jeopardize the proposed St. Lawrence improvement. Those supporting the Illinois waterway project point out that the final decree of the Supreme Court on the Chicago diversion controversy allows a minimum withdrawal of 1,500 sec.-ft. in addition to domestic pumpage. It has been testified by the army engineers that this amount of diversion would be more than ample for navigation purposes. The contention is made, therefore, that opposition to the rivers and harbors bill, on the ground that it provides for diversion from Lake Michigan, is meaningless, since the Supreme Court already has legalized the withdrawal of more water than will be needed.

Hydraulic Laboratory Bill Passes House

Despite formidable opposition, the House passed the National Hydraulic Laboratory bill on April 9. Although there was some objection, the committee amendment preventing the directors of the laboratory from initiating research work that might interfere with some of the government departments was adopted. A further amendment was agreed to which enables the laboratory to take up the problems of states and local governments upon request. The bill will now be sent to a conference between members of the House and the Senate in an attempt to straighten out the differences in the bills that passed the two houses.

Personal Notes

J. Floyd Frazier, of McAlester, has been chosen county engineer of Pittsburg County, Okla.

Major **Mason J. Young** has been ordered to report for duty in the office of the Chief of Engineers, Washington, D. C.

Burton W Marsh, city traffic engineer of Pittsburgh, Pa., has resigned to take a similar position in Philadelphia.

Floyd N. Oakley, superintendent of public works for the city of Ithaca, N. Y., for ten years, has resigned to enter the employ of Flintkote Roads, Inc. He will continue to live in Ithaca.

Major **Holland L. Robb** has been assigned as assistant to the engineer commissioner of the District of Columbia, succeeding Major Layson E. Atkins, who has been transferred to duty as a member and engineer of the Alaska Road Commission.

Frank Feller, formerly assistant city engineer of Ithaca, N Y., has been appointed superintendent of public works.

Major **Douglas H. Gillette** has taken over his duties as assistant executive officer of the Arlington Memorial

Bridge Commission, succeeding Major J. C. Mehaffey, who goes to the Panama Canal Zone. Major Gillette was engineer officer of the Alaska Road Commission from 1927 until early this year.

Charles Brossman, consulting engineer, of Indianapolis, has been appointed a member of the Indiana Building Council by Governor Leslie. Mr. Brossman is president of the Indiana Engineering Society.

Major **Joseph D. Arthur, Jr.**, has been ordered to duty in Washington June 20 as assistant to Major Brehon B. Somervell, district engineer, whom, it is announced, he will succeed on the completion of the latter's four-year term next August.

Harold P. Chapman, of Columbus, has been appointed chief construction engineer of the Ohio Highway Department, succeeding **Robert S. Beightler** who will enter the contracting business in Wooster, Ohio, with **Adolph Stellhorn**, a former engineer in the department.

Charles D. Purdon, consulting engineer (and formerly chief engineer) of the St. Louis Southwestern Railway, has retired from that road after a long period of service. He was born in Ireland in 1850, began his engineering career in Canada in 1870, and then went to the Southwest, where he was connected with a number of the railroads developing that territory, becoming successively locating engineer of the Texas & St. Louis (now the St. Louis Southwestern); assistant chief engineer of the Atchison, Topeka & Santa Fe; chief engineer of the St. Louis-San Francisco, and chief engineer of the St. Louis Southwestern Railway. He is a member of the American Society of Civil Engineers and the American Railway Engineering Association.

Horace H. Chase, who has been associated with the consulting engineering firm of Nicholas S. Hill, Jr., of New York City, for a number of years, has been admitted to partnership in the firm.

C. E. Dorisy, of Seattle, former state sanitary engineer, has been named special city engineer of Mount Vernon, Calif., take charge of the new $100,000 trunk sewer system which the city is building. Mr. Dorisy replaces Arthur E. Dimock, who died suddenly several weeks ago.

Obituary

Ben R. Pearce, of San Diego, Calif., formerly superintendent of highway construction in Arizona, died on April 3, at the age of 36.

Claude M. Thompson, a partner in the contracting firm of Thompson Bros., of Fresno, Calif., died on April 11. He was 48 years old.

Louis Jacob Affelder, of Pittsburgh, Pa., division contracting manager for the American Bridge Co., died on April 8, aged 59. He was a member of the American Society of Civil Engineers and of the Engineers' Society of Western Pennsylvania.

Edwin B. McDonald, 75 years old, a retired engineer formerly connected with the engineering department of the United States government, was found dead in his hotel room in St. Louis, Mo., on April 8.

James W. Paxton, for the past four years connected with the United States engineer office in Jacksonville, Fla., in charge of matters pertaining to preliminary examinations and surveys of waterways authorized by Congress, died on April 2 in a New Orleans hospital. Mr. Paxton, who was born in Baltimore in 1875, was graduated with the degree of civil engineer from Princeton in 1895. He was formerly connected with the city government of Philadelphia and with the district government of Washington, D. C.

Clarence Henry Norwood, president of the Norwood-Noonan Co., Chicago, electrical engineers and contractors, died April 12. He was born at San Francisco, Calif., in 1874, and was graduated from the University of California (school of electricity and mechanics). Mr. Norwood began his career in the shops of the Union Iron Works, San Francisco, and was successively with the Siemens & Halske Electric Co., the Cutler-Hammer Electric Co. and the Commercial Electric Co. He then went into business for himself, and later formed a partnership as the Norwood-Noonan Co. He designed and built electric installations for several large shop plants, pumping stations and power stations. Among his special works was the development of electric operation and control of large drawbridges, several of the Chicago River bridges having his apparatus and equipment. He was a member of the Western Society of Engineers.

Charles Keagle Mohler, consulting engineer and specialist in valuation and street-traffic studies, died at his home in Chicago on April 12. Mr. Mohler was born at Lafayette, Iowa, in 1864, was graduated from Cornell College, Mount Vernon, Iowa, in 1890, and took post-graduate study at Cornell University in 1892. In 1890 he was transitman and then assistant engineer on the Northern Pacific Railway and during the next ten years had appointments on different railways, including four years as assistant engineer of the Erie Railroad. In 1900 and 1901 he was with Ford, Bacon & Davis, consulting engineers, being engaged on electric railway work, after which he had railway engineering and valuation work on the Long Island, the Chicago, Milwaukee, St. Paul & Pacific and the Chicago & Northwestern. In 1904 he took up private practice in Chicago, making a specialty of valuation and city transportation problems. He went to Los Angeles, Calif., in 1912, as chief engineer of the Board of Public Utilities, but some years later returned to Chicago and resumed his private practice. Mr. Mohler was a member of the Western Society of Engineers.

Society Calendar

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; annual meeting, Atlantic City, N. J., June 23-27.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Sacramento, Calif., April 23-24.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, St. Louis, Mo., June 2-6.

AMERICAN WELDING SOCIETY, New York; annual meeting, New York City, April 23-25.

INTERNATIONAL CONGRESS OF BUILDING AND PUBLIC WORKS, London; fifth congress, London, England, May 26-30.

INTERNATIONAL RAILWAY CONGRESS, Madrid, Spain, May 5-15. American vice-president, T. S. Morgan, 119 West 42d St., New York.

WORLD POWER CONFERENCE, second plenary meeting, Berlin, Germany, June 16-25. American secretary, O. C. Merrill, Washington, D. C.

* * *

DISTRIBUTION SECTION, American Gas Association, held its annual conference April 9-11 at St. Louis, Mo. This place was chosen as it is close to the natural gas territory and it was desired to encourage the attendance of engineers working with that fuel. Topics taken up at the conference included pipe joints, metering devices, pipe corrosion, and personnel and customer relations problems.

ENGINEERS CLUB OF FRESNO, Calif., has elected the following officers for the coming year: president, J. Allan Hall, engineer, Fresno Irrigation District; vice-president, A. Segel, consulting engineer; secretary-treasurer, R. D. Likely, operating engineer, San Joaquin Light & Power Corporation.

ILLINOIS SECTION, American Water Works Association, at its annual meeting April 23-24 in Chicago will devote its first session to railroad water service, treatment and sanitation. Other subjects scheduled relate to standard methods of analysis, sanitary standards for reservoirs and the Chicago system. C. R. Knowles is chairman and J. J. Doland, University of Illinois, Urbana, is secretary.

MILITARY ENGINEERS ASSOCIATION OF CANADA at the recent annual meeting in Ottawa considered favorably the question of affiliation with the Engineering Institute of Canada. The matter will be studied further with the idea of forming a military section of the Institute.

NATIONAL ASSOCIATION OF RAILROAD TIE PRODUCERS will hold its twelfth annual meeting at Memphis, Tenn., on April 29 to May 1. Papers on ties and timber treatment by railroad engineers and representatives of the lumber industry are on the program. Roy M. Edmonds, St. Louis, is secretary.

NEW ENGLAND ROAD BUILDERS ASSOCIATION has elected Joseph A. Tomasello, Boston, president; Joseph H. McCormick, Jr., East Providence, vice-president; and Fred E. Ellis, Melrose, Mass., treasurer.

NEW YORK SECTION, American Water Works Association, will hold its spring meeting April 24-25 at Buffalo. Six papers will be presented on water-works problems, and a banquet and entertainment held in Fort Erie, Ont.

NEW YORK SOCIETY OF THE PANAMA CANAL will hold its sixth annual banquet at the Hotel Astor, New York City, on May 3.

PACIFIC NORTHWEST SECTION, American Water Works Association, will meet April 24-26 at Portland, Ore.

SEATTLE CONSTRUCTION COUNCIL, Seattle, Wash., has elected the following officers: president, W. C. Bickford; vice-president, H. L. Nelson; secretary, C. J. O'Shea; treasurer, A. Van Doren.

Construction Equipment and Materials

Portland Cement Association Awarded Safety Medal

Recognition of its work in promoting safety in cement plants has been given to the Portland Cement Association by the award of a certificate of honor by the Joseph A. Holmes Safety Association, which is closely allied with the U. S. Bureau of Mines. In awarding the certificate, it was pointed out that in 1924, the year in which the association started its safety campaign, only one plant out of a total of 105 operated throughout the year without a single lost-time accident, whereas in 1929, 28 out of 153 plants achieved this distinction.

A similar certificate was also awarded to the Lehigh Portland Cement Co. for its excellent safety work and safety record. At least one plant of this company has completed the calendar year without a lost-time accident in every year except one since 1924. In 1928 five plants had no lost-time accidents, and in 1929, four. The company's plant at Iola, Kan., has not had a lost-time accident to any of its more than 200 employees since Sept. 10, 1926, nearly 3½ years, and its plant 3, at Ormrod, Pa., has now gone more than two years without a lost-time accident.

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded during the month of March, 1930, and also the total number of square yards awarded for roads, streets and alleys in the United States for the year 1930 to date as of March 29:

	Sq.Yd. Awarded During March, 1930	Sq.Yd. Awarded From Jan. 1, 1930, to March 29, 1930
Roads........	11,294,228	28,895,395
Streets.......	2,194,377	4,954,890
Alleys........	211,127	330,829
Totals.....	13,699,732	27,181,114

Railway Tie and Timber Meeting Program Announced

On the program for the annual convention of the National Association of Railroad Tie Producers, at Memphis, Tenn., April 29 to May 1, are the following papers: "Separation of Ties by Grades," T. H. Wagner, Jr., manager, T. J. Moss Tie Co.; "Hardwoods in the Lower Mississippi Valley," G. H. Lentz, U. S. Forest Service; "Future of the Wood Tie," C. C. Warne, assistant purchasing agent, New York Central Railroad; "Seasoning and Treating Water Oak," N. W. McGough, treating engineer, Texas & Pacific Railroad; "Extended Use of Treated Timber," C. C. Cook, maintenance engineer, Baltimore & Ohio Railroad; "Anti-Splitting Devices," C. W. Greene, timber-treating engineer, New York Central Railroad; "Tie Production From the Railroad Standpoint," C. E. Johnston, president, Kansas City Southern Railway; "Protection of Ties Before Treatment," J. R. Keig, manager, Kirby Lumber Co. The secretary is Roy M. Edmonds, St. Louis, Mo.

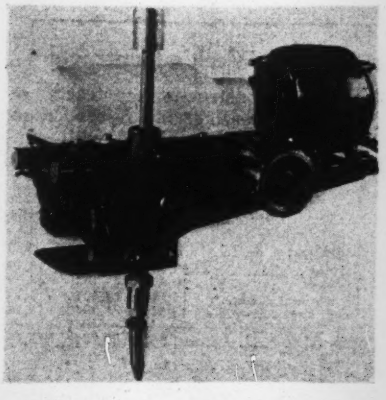
Copper Price Drops 4 Cents

World copper prices were reduced 4c. per pound April 16 from the 18c. level set by the Copper Export Association in April, 1929. The new prices are 14c. domestic and 14.3c. export. The reasons for the break were cumulative: (1) declining exports, (2) increasing imports attracted by the high price, (3) stocks ten times those of a year ago, (4) substitution of cheaper metals, (5) depression in general business. The result is expected to be an immediate loss to copper companies, lower wages in the industry and larger consumption of copper.

New Developments

Feeding Device for Heavy Welding Wire

Automatic welding calls for increased welding speed, requiring heavier welding current and larger sizes of electrode wire than ordinarily used. To meet the need for an automatic welding head capable of handling heavy wire the General Electric Co., Schenectady, N. Y., has improved its welding head by the addition of a geared drive to what was formerly the idler roller in the feeding mechanism. In this way large sizes of wire are positively fed with a moderate pressure between the driving rolls. The device also extends the uses for automatic welding by making it possible to use curved nozzles so as to reach into otherwise inaccessible places and to weld in abnormal positions. The improved drive rolls gears furnished on welding heads for these applications will now accommodate any size wire from ⅛ to ¼ in. without changing gears. Below ⅛ in. the gears are not needed and can be removed. Sufficient pressure for feeding small sizes of wire is obtained by screwing down the adjustment on the binding roll.



IMPROVED DRIVING HEAD FOR AUTOMATIC WELDER

Gasoline-Electric Power Unit for Small Track Tools

Electricity for operating tie tampers, spike drivers, nut-tightening wrenches, power hacksaws and other small tools on railway track work is supplied by a new model power unit manufactured by the Syntron Co., Pittsburgh, Pa., in five sizes ranging in capacity from 3½ to 20 kva. Electrical equipment in these units is manufactured by the Westinghouse Electric & Mfg. Co., of East Pittsburgh. Both motor and generator are housed to provide protection from the weather and are designed for lightness in weight and small size. The narrow width of the unit does away with the necessity of providing cribbing, as it can be set on the shoulder of the track with plenty of clearance for passing trains. Light weight makes it possible for five or six men to move or set up the unit, which is mounted on skids with side rollers.

GASOLINE-ELECTRIC POWER UNIT

Tractor Attachment for Digging in Close Quarters

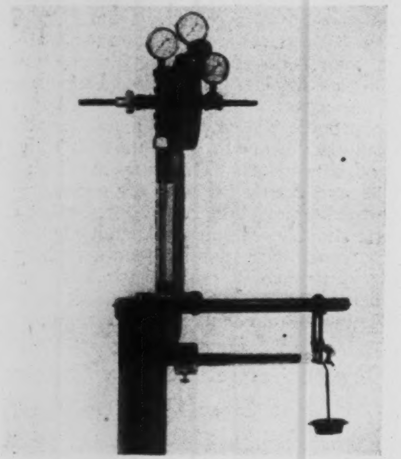
Production has been started by the Miami Trailer-Scraper Co., Troy, Ohio, on a shovel device for attachment to the Caterpiller 15 tractor which is particularly adapted to excavation in limited spaces. This unit has a vertical clearance, with shovel lifted, of 44 in., which is reduced to only 30 in. with the shovel in dumped position. The bucket, of ½-cu.yd. capacity, is well reinforced and is fitted with a reversible cutting edge. It is attached to the tractor by means of a framework of channels, I-beams and tubular sections and is operated by a winch mounted on the rear of the tractor. As the winch case attaches directly to the rear of the transmission, no power take-off or stationary drive is required. Gears are machine cut and operate in oil. Shafts are of alloy steel mounted in roller bearings. Control is

TRACTOR SHOVEL DIGGING FROZEN GROUND

by means of a heavy-duty clutch and a special brake which holds the drum in any desired position. The drum has a maximum speed of 71 ft. per minute. Sheave assembly bolts are hardened and ground, and sheave wheels are bushed and provided with Alemite lubrication.

Ammonia Control Unit Meters Flow of Gas

Treatment of water supplies ahead of chlorination to reduce tastes and odors is a process which is rapidly gaining favor. For this purpose a control unit which automatically maintains any desired flow of anhydrous ammonia gas, regardless of changes in supply or discharge pressure, has been recently developed by the Pardee Engineering Co., Long Island City, N. Y. The device consists essentially of a control valve with adjustment flow, a meter which shows how much gas is flowing, two diaphragm valves which automatically maintain the flow, and auxiliary gages to aid in operation. It is made in two types, a bubbling meter with a capacity from 0.02 to 1 lb. per day, and an orifice meter in larger sizes ranging from 0.4 to 200 lb. per day. Larger capacities can be provided where desired. The unit is usually mounted on a short stand which is attached to the arm of a platform scale on which the cylinders are placed but can, if preferred, be mounted on a floor stand or a bracket for attachment to the wall or pipe. It is constructed entirely of cast iron and steel, the important valve parts being made of a special stainless steel to resist corrosion. As gas flows continually through every part of the apparatus, there is little likelihood of fouling. The manufacturer claims that the unit is easy to operate and simple to maintain, as any good plant mechanic can take it apart and make replacements and repairs without danger of breakage or loss of accuracy.



AMMONIA METER MOUNTED ON SCALE ARM

New Publications

Pumps — Bulletin 400, entitled "Pump-Fax," has been compiled for Goulds Pumps, Inc., Seneca Falls, N. Y., by F. G. Switzer, professor of hydraulic engineering at Cornell University. It contains 51 pages of data on the problems of moving liquids of any kind, as well as a number of additional pages illustrating pumps manufactured by the company. Reciprocating, centrifugal and rotary pumps are compared and described and directions given for installation and operation. Twelve tables are included.

Diesel Engines—How the method of injection used in Cummins diesel engines was developed and perfected is explained very clearly in a 32-p. booklet, "The Mechanical Principles of the Cummins Diesels," published by the Cummins Engine Co., Columbus, Ind. Besides treating of injection problems, the book describes other important mechanical features of the engines. A separate publication recently issued describes and gives general specifications of the Cummins model K stationary diesel engine.

Roller Bearings—Design data for roller-bearing installations is given in great detail in a 36-p. catalog 40, issued by the Roller Bearing Company of America, Trenton, N. J. Besides approximately twenty pages of tables, the booklet contains a discussion of shock-absorbing characteristics, alignment, race and roller assembly, mounting, lubrication and protection and other details of interest to bearing designers and users.

Steel Buildings—"Standardized Service in Steel for One-Story Buildings," a 12-p. illustrated booklet issued by the Macomber Steel Co., Canton, Ohio, describes how, by the use of standardized structural parts for buildings, the advantages of standardization can be retained and still permit complete flexibility in exterior and interior arrangement. Detailed attention is given to the construction of sidewalls, roofs, ceilings and floors. Standardized steel elements available include roof trusses, decking and purlins, columns, framing, bar joists, sidings, windows, doors and metal lath.

Welding—Photomicrographs showing the effect of various flux compositions upon welds, together with explanatory text, are given in great detail in a 14-p. bulletin 62 issued by Alloy Welding Processes, Ltd., Ferry Lane Works, London, England.

Motor Control—Principles of the selection of motor control to suit the load for either direct or alternating-current motors are explained in "Practical Pointers on the Selection of Motor Control," issued by Cutler-Hammer, Inc., Milwaukee, Wis.

Rollers — Buffalo Springfield Roller Co., Springfield, Ohio, has issued a new 30-p. catalog, illustrated in color, describing two- and three-wheel motor road rollers.

Portable Electric Tools—Electric drills, screwdrivers and grinders are described in the new catalog 30 issued by the Schauer Machine Co., Cincinnati, Ohio.

Concrete Admixture—Pacatome Co., San Francisco, Calif., has issued several bulletins dealing with the use of diatomite for increasing the plasticity, impermeability and uniformity of concrete.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Apr. 1,	**1930**	**207.12**	**March,**	**1930**	**408**
Mar. 1,	1930	206.80	February,	1930	204
Apr. 1,	1929	203.40	March,	1929	382
Average,	1929	207.02	Average,	1929	317
Average,	1928	206.78	Average,	1928	287
1913........		100.00	1913............		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of April 17, with some comparisons, total as follows:

(In Thousands of Dollars)

	Apr. 17, 1930	Average Preceding Four Weeks 1930	1929
Buildings:			
Industrial.......	$3,083	$11,532	$8,528
Other	30,897	43,745	44,008
Streets and roads..	15,459	12,501	5,331
Other eng. constr..	12,246	41,994	15,588
Total............	$61,685	$109,774	$73,456

Total, all classes, Jan. 1 to Apr. 17:

1930	$1,048,814
1929	1,369,981

Business Notes

Rail Steel Bar Association will hold its regular semi-annual meeting May 9 in New York City, in conjunction with the sessions of the American Iron and Steel Institute.

W-K-M Co., Inc., Houston, Tex., has appointed Alexander J. Duaei manager of sales for the Western territory, with headquarters at Chicago. Mr. Duaei was formerly with the Johns-Manville Co., as manager of the public utilities division.

O. K. Clutch & Machinery Co., Columbia, Pa., has opened an office in New York City in charge of R. B. Palmer, Jr.

Trackson Co., Milwaukee, Wis., has appointed the Edward R. Bacon Co., San Francisco, Calif., its distributor in the San Francisco territory, and the Olympic Machinery Co., Seattle, Wash., distributor for the State of Washington.

Day & Maddock Co. and Peden Equipment Co., Cleveland, Ohio, have merged and will operate in the future as the Day & Maddock Co.

American Manganese Steel Co., Chicago Heights, Ill., announces the election of A. W. Daniels as vice-president in charge of sales.

Willard Equipment, Ltd., Vancouver, B. C., has been appointed distributor in British Columbia and Alberta for the Bucyrus-Erie Co., of South Milwaukee, Wis.

Chain Belt Co., Milwaukee, Wis., has appointed two new distributors in its construction equipment division. The R. B. Everett Co., Houston, Tex., will handle the complete line of construction equipment, and the J. D. Adams Manufacturing Co., Indianapolis, Ind., will act as exclusive distributor in the Indianapolis territory for the new Champion Rex Paver and the Rex Road Pump.

De Walt Products Corp., Lancaster County, Pa., has acquired two new products, the Wodack electric hand saw and the Wodack electric combination mortiser and router.

Henry M. Toch is celebrating the 50th anniversary of his association with the firm of Toch Bros., New York City, manufacturers of waterproofing and dampproofing compounds and paints.

Thomas Addison, who served for 31 years as Pacific Coast manager of the General Electric Co., with headquarters in San Francisco, until his retirement in 1923, died suddenly in Berkeley, Calif., April 8, at the age of 76. Educated originally as a physician, Dr. Addison gave up his practice to enter the employ of the United States Electric Co., of Chicago. In 1888 he became an apparatus salesman for the Thomson-Houston Co. in Chicago, and when in 1890 the Western branch of the company was reorganized, he was sent to San Francisco as local manager. Two years later he became Pacific Coast manager of the General Electric Co.